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HANDBOOK

FOR THE

8-INCH R.M.L. HOWITZER OF 70 CWT.

FOR

MOVABLE ARMAMENT

AND

ARMAMENT OF WORKS.

MELBOURNE
14 SEP 97

1895.

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LONDON:
PRINTED FOR HER MAJESTY'S STATIONERY OFFICE,
BY HARRISON AND SONS, ST. MARTIN'S LANE,
PRINTERS IN ORDINARY TO HER MAJESTY.

And to be purchased, either directly or through any Bookseller, from
EYRE & SPOTTISWOODE, East Harding Street, Fleet Street, E.C.; or
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Memo.

This book is corrected up to 1895. Any alterations which may be suggested should be forwarded to Chief Inspector, Woolwich Arsenal.

HANDBOOK

FOR THE

8-INCH R.M.L. HOWITZER OF 70 CWT.

14 SEP 97

THE HOWITZER.

(*Plate I.*)

Material	Mark I.	exterior	Wrought iron.
		tube	Tough steel.
	Mark II.	(throughout)	Steel.
Length, total			113 inches.
Weight, nominal			70 cwt.
Preponderance, muzzle (about)			12 lbs.
Bore	calibre		8 inches.
	length		96 inches = 12 calibres.
	capacity, including unrifled portion		4958 cubic inches.
Chamber	diameter		8 inches.
	length		8 inches.
	capacity		397 cubic inches.
Rifling	system		Polygroove, plain section.
	twist		Increasing from 1 turn in 90 calibres at breech to 1 turn in 35 calibres at muzzle.
	length		88 inches.
	grooves	number	24.
		depth	0·05 inch.
		width	0·7 inch.
Vent			Vertical, of hardened copper, 2 inches from end of bore.

In order to ensure an exact space in the bore being left for the charge, the grooves terminate abruptly at a distance of 8 inches from the end of the bore, so as to prevent the projectile being driven beyond this point; the grooves are splayed at the muzzle and the howitzer is slightly bell-mouthed, to facilitate loading.

Planes for cross-levelling are cut upon the cascable button and front portion of the breech coil (Mark I), or jacket (Mark II), and a plane for quadrant elevation on the top of the breech.

A "plate, elevating," for the attachment of the elevating arc, is fixed to the right side of the breech, and is adapted to fit the piece for the siege travelling carriage.

The weight and external dimensions of Mark II Howitzer are the same as those of Mark I, but its construction differs in that it is made wholly of steel. The cascable is a continuation of the A tube, and not a separate part as in Mark I.

A gas escape is cut across the threads of the cascable of the Mark I Howitzer, the channels being visible on the right-hand top side of the face of the breech. Mark II has no gas escape.

Sights.

(*Plate* II.)

The piece is sighted upon both sides on a plan proposed by Colonel French, R.A.

The tangent sights drop into sockets, and are set vertically. The vertical bars, which are of steel, are graduated to 15 degrees, adjustment being effected by removable clamps. The sights have bronze heads with clamping screws, and a steel horizontal cross-bar, which slides within the head to the extent of 1° to the right and 3° to the left, to compensate for wind and deflection of projectile. The bar is provided with a sliding reversible leaf, having a notch for direct laying; this leaf is provided with a pointed sight for rough laying, and cross-wires for fine laying when used reversed. The bar is graduated from 0° to 8° right for the right side, and 0° to 8° left for the left side. The bars are reversible, being graduated upon one edge for the right side, and on the opposite edge for the left side of the piece, and are stamped accordingly.

The fore-sights consist of steel stems with horizontal cross-bars, forged solid, fitted into gun-metal sockets with bayonet joint. The bars are each fitted with a sliding reversible leaf, having a point for direct laying, and an open notch and eye-hole for rough and fine laying when used reversed. Fore-sights are numbered on the stem with the number of the piece for which they are intended, and are not interchangeable.

The cross-bars are graduated from 0° to 8°, to correspond with the cross-bars of the tangent sights.

These sights can be used for either direct or reverse laying.

For direct laying, the notch of the tangent sight is used in conjunction with the point on the fore-sight; for fine laying, the sliding leaves are exchanged, and the eye-hole and cross-wires used in conjunction. For direct laying, the method of proceeding is the same as when using service sights of the ordinary pattern, the only special feature being, that both sliding leaves must be clamped at corresponding divisions of the respective cross-bars, so as to obtain a line truly parallel to the axis of the gun; any deflection which may be required is given on the part of the bar specially graduated for the purpose.

For reverse laying, the notch of the fore-sight is used in conjunction with the point on the tangent sight, or the eye-hole of the fore-sight with the cross-wires of the tangent sight.

The mode of proceeding is as follows:—

The line of fire is obtained by any of the recognised methods, and a banderol placed in the line at a convenient distance (40 to 50 yards

if possible) in rear of the howitzer. The howitzer loaded and run up is laid without deflection, and with the sliding leaves of fore and hind sights clamped at similar graduations, back on the banderol, and consequently in the line of fire. An auxiliary mark in rear is then picked up, by sliding the leaves of the fore and hind sights till they are aligned on the mark, care being taken that the howitzer is not shifted. To align the sights the tangent sight may be raised to any convenient height. The readings at which the sliding leaves are clamped must be carefully noted and also chalked on the piece. Deflection can be given in the ordinary way, the piece being then relaid on the auxiliary mark. Direction should always be given by laying on the auxiliary mark, which, so long as it can be clearly seen to lay on, should be as far back as possible. The description of the auxiliary mark should be noted and chalked on the piece. The howitzer will be laid for elevation by clinometer, after being laid for direction.

For night firing, or when there is much fog, a luminous auxiliary mark is required. For this purpose a bull's-eye lantern is used, contained in a wooden box. In the door of the box is a circular hole, large enough to show the full light of the lantern when used as a distant auxiliary mark, and a brass slide with a cross-cut aperture is fitted behind the door to limit the light when it is suspended close in rear of the emplacement.

The following sights and fittings are issued with the piece:—

Clamps, tangent sight "B"		bronze	2
Plate, elevating		bronze, with pivot, keep pin, and fixing screws	1
Screws, plate, elevating, preserving			4
Sights, R.M.L. cross-bar	fore	steel	2
	tangent	„	2

Care and Preservation of Howitzer and Fittings.

The howitzer should be examined after firing 100 rounds with projectiles.

When not in use the bore will be lacquered; when practice is being carried out it will be kept slightly oiled, to prevent rusting. At the close of each day's practice the howitzer will accordingly be washed out and placed under metal, and as soon as dry will be oiled with a greasy sponge and the muzzle closed with a tampeon.

The clinometer planes are not to be painted, and should never be cleaned by filing or by the use of brick dust, &c. To clean them, use a soft rag and afterwards oil them lightly.

The sights should be kept clean, free from grit, and oiled; the sliding leaves and cross bars should have free play.

The exposed portions of the sights are bronzed if made of gun-metal, and blued if of steel. This is done to preserve them from corrosion, and on no account are these parts to be burnished or cleaned in such a manner as to remove the bronzing or blueing.

Elevating plates will be removed for transport, and the holes in the howitzer filled by preserving screws.

Carriage, Siege, R.M.L., 8-inch, 70-cwt., Howitzer (Mark I).

(*Plate III.*)

The carriage used for this howitzer is that made originally for the 64-pr., but strengthened and fitted with a hydraulic buffer.

The carriage is formed of two bracket sides, connected by transoms, bolts, and a trail piece with steel eye. It is strengthened by a plate near the centre transom forged with a lip at each end, and secured to the top flanges of the angle frames of the brackets to restrain any outward tendency. It has an axletree bed with first-class axletree, and wheels (1st class, "B," No. 6) with metal naves and phosphor bronze pipes.

Each bracket is constructed of plate iron, riveted to the inner side of an angle iron frame, and is provided with firing and travelling trunnion holes.

The axletree bed is of wrought iron, constituting with the axletree a beam of box girder section; it is connected to the brackets by angle stays.

The elevating gear is fitted on the right side only. It consists of a worm spindle, with hand wheel, held in bearings on the outside of the carriage bracket, gearing into the teeth of a worm wheel (fitted with friction cone), which gives motion to a pinion on the inside of the bracket gearing with the arc attached to the gun. The arc is kept in gear with its pinion by a metal friction roller on the bracket. The worm wheel and spindle are covered by a metal guard made in two parts, and hinged together so as to give ready access to the wheel, &c.

The friction cone in the worm wheel should be adjusted by the nuts on the end of the spindle, to allow a slip of about 2° each time the gun is fired, to reduce the strain on the elevating gear.

A stool bed of wood, strengthened by angle iron along each side, a large coin, a hand coin, and a small hand coin are fitted to and issued with each carriage for use in laying the gun, in case of any damage to the elevating gear; the stool bed also serves as the shifting plank for the gun roller (also supplied) when required to shift the howitzer from or to the travelling trunnion holes.

The brake at present fitted to most of these carriages in the movable armament is applied by a lever, which is connected by a cross shaft and tension rods to a transverse bar of channel iron. This bar has at each end a steel spring, to which is attached an iron shoe fitted with a wooden block. The lever works on a circular rack-plate on the outside of the right bracket. The transverse bar is supported in guides fixed beneath the carriage.

For future manufacture the brake will be altered as follows:—

The brake blocks will be applied by two hand wheels, instead of by a lever. The connecting rods of the old gear will be replaced by similar rods, with a square-threaded screw cut on the front end of each, to engage with a nut formed in the boss of the hand wheel; the hand wheel being held in position by a bracket fixed near the front end of the carriage. The brake shaft will be in two pieces, with the inner end of each pivoted in a bracket fixed to the centre transom; this arrangement will admit of the blocks being applied singly or together. This is the brake shown on Plates III and IV.

Either form of brake is only intended for use while travelling, and is to be removed before coming into action.

A pocket for prickers is strapped on the rear transom.

The carriage is fitted to carry a hydraulic buffer suspended under it. The piston rod is connected to the trail by the bar (*a*) which is secured by the pins (*bb*), and supported by the bracket (*c*). Two boss plates are riveted between the trail brackets at (*b*) through which the securing pin passes.

The siege travelling carriage, fitted with hydraulic buffer, is intended to be used on a double-decked siege platform, furnished with C pivot, wheel plates, and trail plank.

Hydraulic Buffer.

The buffer is of special pattern for use with siege carriages; the front and rear caps are of wrought iron, and screwed on the cylinder; a ring with trunnions is secured near the centre of the cylinder, and connected with the front cap by tie bars; the front cap is arranged for a leather packing ring, and also for cotton instead of the usual hemp packing. The piston rod is 2·75 inches diameter; and the front end is screwed to receive a link, by means of which it is shackled to the connecting rod.

The buffer is fixed to the carriage as follows: The buffer cylinder is secured by its trunnions to the pivot plug which is inserted into the pivot of the double-decked platform, and the piston-rod is attached by the connecting rod to the trail; when the carriage is run up the piston-rod is driven into the cylinder, the oil passing to the rear of the piston; when the gun is fired the piston is drawn along the cylinder, and the resistance of the fluid to its passage checks the recoil.

In the hydraulic buffers for siege carriages the size and number of holes in the piston do not vary. There are four holes of 0·35 inch diameter.

The buffer is 5 feet $1\frac{1}{2}$ inches long internally, the piston is 2 inches thick, thus the buffer allows of a possible recoil of 4 feet $11\frac{1}{2}$ inches; practically 4 feet 9 inches should never be exceeded.

——	Charge.	Working quantity.	Quantity to be drawn off.
	lbs.	quarts.	quarts.
Working contents of buffer to allow about 4 feet recoil.	$11\frac{1}{4}$	$20\frac{1}{4}$	0
	7	16	$4\frac{1}{2}$
	$3\frac{1}{4}$	—	—

Before action, see that the cylinder contains the requisite quantity of oil, and that there is no leakage at the gland.

To fill the cylinder with oil—Run the carriage up, take out the screw plug, and rest the gallon measure in the hole, turn off the cock, and fill the measure with mineral oil to the gallon mark, then turn the cock and allow the oil to flow into the cylinder. Repeat the operation until the buffer is full ($5\frac{1}{8}$ gallons); then draw off sufficient to reduce the contents to the required quantity.

Oil is withdrawn by means of the front screw valve, air being let into the cylinder at the same time by the unscrewing of the front plug.

If leakage occurs at the gland, and tightening up the latter does not remedy it, the packing must be renewed.

To renew the packing: Remove the packing on the piston-rod, unscrew the metal gland with the spanner provided (spanner, hydraulic buffer, No. 1), and with the tang of a file extract the cotton packing, then by drawing out the rod, the remaining portion of the packing, *i.e.*, the metal ring and leather collar will come out with it. Place the new leather on the rod so as not to damage its thin edge, follow it with the metal ring, and press them both home to the bottom of the stuffing box, then after inserting the cotton packing, tighten up the whole with the metal gland. The cotton rings must be a quarter of an inch less in length than the circumference of the piston-rod, and have the ends bound with cotton yarn. When required for use the rings must be well greased with tallow, and placed in the stuffing box, so that the ends do not coincide. If necessary to withdraw the piston and rod from the cylinder, warm the cap with a piece of hot iron (which by softening the red lead and expanding the iron facilitates removal), unscrew it by tapping the spanner with a hammer; the shackle should be detached, and the gland slackened before removing the piston-rod. During this operation great care must be taken to prevent damage to the component parts.

To replace the piston and rod:—Slide the latter up the cylinder to the front cap, then with the tang of a half-round file inserted through the stuffing box, prise it into its bearing, while it is being forced forward from the rear. Before replacing the cap, coat its thread and that of the cylinder with red lead.

Dimensions of Carriage.

			ft.	in.
Height to centre of gun			4	5
Length of carriage	with wheels		11	10½
	without		10	11½
axletree			6	3
Angle of trail				19°
Elevation, maximum				35°
Depression				5°

		ft.	in.
Wheels	track	5	2
	diameter	5	0

		cwt.	qrs.	lbs.
Weight	carriage, with wheels, drag-shoe, and elevating gear	45	0	0
	wheels (2)	10	2	0
	hydraulic buffer, empty	4	1	0

List of stores that are carried on the carriage—

(*See* Plate XI.)

	No.
Arc, elevating	1
Coins, wood, hand { No. 4	1
Coins, wood, hand { No. 7	1
„ „ carriage, No. 5	1
Hammer	1
Handspikes, 7 ft.	5
Pincers (pair)	1
Spanner, McMahon, 15-inch	1
Stool bed	1
Water brush	1
Drag-shoe and chain	1
Roller, shifting, No. 3	1
„ Scotch	1

Carriage, Siege, R.M.L., 8-inch, 70 cwt. Howitzer, (Converted 8-inch 46 cwt.) Mark I.

(*Plate IV.*)

This carriage differs from that described above in having brackets of double plate construction with wrought-iron frames, and in having the axle-tree and its bed housed in the brackets, level with their bottom edges and covered in by a $\frac{3}{4}$-inch bottom plate. The carriage has thus a flush bottom.

The elevating gear, brake, and fittings for hydraulic buffer are similar to those described above.

Platform, Siege, Double Decked, C. pivot (Mark I).

(*Plates III and IV.*)

The platform consists of two layers of 3-inch fir planks, those of the bottom layer parallel to the line of fire, those of the upper layer at right angles to it; under the bottom layer are placed four transverse planks, similarly to those in the top layer, one at the front, another at the rear of the platform, the other two between them, one being 4 feet 6 inches from the front, and the other 5 feet 3 inches from the rear, transverse plank. Distances measured in the clear.

The planks of the upper layer are connected at each end to those below by 5-inch screws. Both layers of planks are connected to the four lowest transverse planks by 8-inch screws. The screws are "cheese-headed" screws.

One platform consists of :—

Bottom layer, 16 planks—18 ft. by 9 in. by 3 in.
Top layer, 24 „ } 12 ft. by 9 in. by 3 in.
Transverse planks, 4 }
40–5-inch screws, $\frac{5}{8}$-inch diameter.
64–8-inch screws, $\frac{3}{4}$-inch diameter.

These platforms should be laid at a slope of 1 in 24 (2° 23') to the front, with a clear space of 1 foot between the front of the platform and the foot of the interior slope.

The object of this arrangement is—

1. To leave a sufficient gangway between the front of the wheels and the interior slope, so as to enable the Officer, or No. 1, who lays the gun, to pass round to the front of the trunnions, when the gun is in the firing position to lay "reverse."

2. For convenience of drainage.

3. To prevent the earth and stones shaken down by the shock of firing falling on the platform.

All siege carriages fitted with hydraulic buffers, whether mounted in permanent works or in hastily-constructed positions, will be attached to a central pivot, fixed to the double-decked platform. Plate III shows the pivot arrangement attached to the platform.

The pivot plate (*d*), is a circular steel casting, with a socket in the centre, to suit either a pivot plug (*e*), to which the howitzer buffer is secured, or a radial arm for B.L. guns on overbank carriages. It is secured in position by 12 bolts, which pass through the planks and a steel plate on the under-side of the platform. The pivot plug (*e*) is a steel forging in which bearings are formed for the trunnions of the hydraulic buffer.

The buffer is secured in the bearings by two caps.

	cwt.	qrs.	lbs.
Weight of platform with pivot plate ..	43	2	26
„ plug, pivot	2	2	0

Plate, Steel, Wheel, Platform, Siege (Mark I).

The wheel plates are of steel, 18 inches by ½ inch by 6 feet. One of these plates is to be placed under each wheel of the carriage to protect the upper layer of the platform, and so that its front edge is in line with the rear edge of the third plank of the platform from the front.

	cwt.	qrs.	lbs.
Weight of each	1	2	10

Plank, Trail, Siege (Mark II).

The trail plank is of oak, 12 inches by 3 inches by 6 feet, shod on both sides for the whole of its length with channel steel, and fitted with four rope handles. It is to be placed under the trail of the carriage to preserve the ground platform from injury. It should be placed under the centre of trail, the end projecting about 6 inches in front of trail. The plank should be in the line of recoil.

Limber, Siege, R.M.L. (Mark I).

(*Plate* V.)

The limber is the wrought-iron siege limber, common to the beds and carriages of all pieces in the siege train; the futchels and splinter-bar are of wrought iron; the axletree bed is also of wrought iron; and, with the axletree, constitutes a beam of box-girder section.

The wheels are second-class "B," No. 25, or 2nd class "C," No. 39. The washer is a "loop washer," having a shorter loop than the usual drag washer.

The limber is fitted with a limber-hook steeled, with a piece of steel welded in, to prevent wear, and fitted with a steel key $1\frac{1}{4}$-inch diameter.

The shafts are one pair "near" and "off," the former being of the field pattern, and the latter similar to the field pattern, but having a loop on the iron for the stay of the outrigger; also another pair "framed" and attached to the splinter-bar. There are outriggers for four-horse draught.

		cwt.	qrs.	lbs.
Weight	limber and shafts	6	3	22
	wheels	4	2	4

There is only this one pattern of limber, but it is fitted with different boxes according to the service for which it is intended.

(i) When used with the siege train, it carries a "*Box, limber, R.M.L. Howitzer, Mark I,*" which is the same for all the howitzers of the siege train. For list of stores carried in this box, see Siege Artillery Drill.

(ii) When used with movable armament, a smaller box with a sloping lid is carried, called "*Box, limber, R.M.L. 8-inch, 70-cwt., and 6·6-inch Howitzer, Mark I.*"

The weights of these boxes (empty) are:—

	cwt.	qrs.	lbs.
(i)	1	0	12
(ii)	0	2	13

The limber box (ii) carries the following stores:

(*See* Plate XI.)

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	No.
Can, oil lubricating (short can)	1
Case, powder, metal-lined, keys	1
Chalk, white .. .. ozs.	4
Clamps, tangent sight	2
Clinometer (in case)	1
Clippers, portfire	1
Cloths, sponge	4
Cylinders, with 6 bits	1
Driver, screw, 6-inch	1
Drivers, screw shrapnel	1
Extractor, fuze	1
Hook borer	1
Keys, fuze, universal, Mark II	1
Knife, clasp	1
Lanyards, friction tube, siege, No. 1	3
Line, carpenter's	1
Line, hambro	1
Marline .. .. lbs.	1
Match, slow .. .. lbs.	1
Pin, linch, 1st class	1
Pin, linch, 2nd class	1
Pincers, shrapnel primer	1
Plates, elevating, with screws	1

	No.
Plummet, howitzer	1
Pocket, tube	1
Portfires, common	2
Pricker, vent, 7-inch	1
Reel, carpenter's line	1
Sight, cross-bar, tangent	2
Sight, cross-bar, fore	2
Spanner, hydraulic buffer, No. 6	1
Spike, spring, C	1
Spikes, common	2
Stick, portfire	1
Ties, linch pin	20
Tubes, friction	25
Twine, packing, small .. .. .. lbs.	1
Vent servers, with lanyards	2
Washer, loop, 2nd class, B	1
Washers, leather, plug, filling, hydraulic buffer, in tin box	3
Wrench, pivot, No. 4	1

The following stores are carried on the limber :—

	No.
Box, tin, grease, 3 lbs.	1
Buckets, G.S.	1
Bill hook	1
Drag washer, 1st class, " B "	1
Drag ropes .. .. pair	1
Lifting jack, Clerk's	1
Maul	1
Pick axe	1
Swingletrees, No. 1	3
Shovel	1
Spade	1
Spanner, hydraulic buffer, No. 1	1
Water brush	1
Bull's-eye lamp, in box	1

Notes on Packing.

There are fittings for all the above stores, but as some of them are only allowed in the proportion of 1 to 2 or 3 howitzers, all of them will not always have to be carried.

A hand-cart and a trench-cart are allowed to each howitzer for the supply of ammunition, the cartridges being carried in the former, packed in metal-lined cases ; the projectiles are carried loose in the trench-cart.

Besides the ammunition, the carts will also have to carry the following articles, which are required for the service of the howitzer, but for which there are no fittings on the carriage or limber :—

	No.
Scotches, large	2
Colours, camp	2
Cases, cartridge	2
Bearer, shot	1

	No.
Rammer	1
Sponge	1
Wadhook	1
Extractor	1

General Instructions for Care and Preservation of Carriages.

Care should be taken that all nuts and screws are properly tightened up, on no account should a hammer be used in doing this.

A nut, screw, or bolt if removed, should be slightly oiled before being replaced, and a few turns should be given by hand before employing the spanner, to prevent damage by the threads crossing.

All bright parts should be kept clean, and when not in use slightly greased. All bearings should be kept clean, and lubricated through holes provided for the purpose. All working parts, viz., axles, spindles, pinions, compressor and adjusting nuts and screws, rocking levers, pivots, and arcs must be kept free from clotted oil, dirt, and rust.

The axletrees and grease chambers of the wheels should be frequently cleared from clotted grease, and all dirt and grit removed before lubricating. To insure thorough lubrication, the chambers must be kept filled with grease.

Store boxes should be removed occasionally and examined underneath. Care must be taken to prevent the lodgment of water on any part of the mounting.

When carriages are parked, or placed in a shed with the shafts exposed, the latter should be raised on the props to keep the shafts dry.

Defects or damage should be made good without delay, and if the paint becomes rubbed off at any part, it should be patched over as soon as possible.

Projectiles.

		Total weight about lbs.	ozs.
Shell	common, iron, Marks I and II ..	185	0
	„ steel, Mark III	180	0
	Shrapnel, steel, Mark I	180	0
	star, spherical, Marks I to IV ..	22	0
Shot, case, Marks II and III		74	0

The common and Shrapnel shell are studless, and are rotated by a copper automatic gas-check.

Common Shell.

(Plate VII.)

The Mark I shell is of iron, cast to the finished dimensions, the body being unturned, leaving 0·15-inch windage. Bands are left at the head and base 1·5-inch in width, turned down to a windage of 0·05 inch. It is screwed at the base to receive a metal base plug. The interior is lacquered.

Mark II only differs from Mark I in having the bush of the fuze socket made with a flange.

The Mark III shell is of cast steel instead of iron; it is longer and has thinner walls than the Mark II, and thus contains a larger bursting charge.

	Mark II.		Mark III.	
	lbs.	ozs.	lbs.	ozs.
Weight empty, with base plug	160	5	147	0
„ of gas-check	6	2	6	2
„ bursting charge { P.	16	0	22	3
„ bursting charge { F.G. ..	2	8	3	12
Total weight, about ..	185	0	180	0

In the siege train common shells are sometimes filled with incendiary stars, but none of the latter are allowed for movable armament.

*Shrapnel Shell (Mark I).**

(Plate VII.)

The body of the shell is made of cast steel, annealed after casting. It is cast with bands which are turned to final dimensions. The base for a length of ·9 inch is reduced in diameter, with a circular groove for attaching the gas-check; 37 serrations are cast on the base, by means of which the gas-check imparts rotation to the shell. A hole is bored in the base and screwed 14 threads to the inch, left hand, and

* Note.—The use of Shrapnel shell with howitzers has been discontinued for the present.

countersunk, into which is fitted a gun-metal plug screwed to suit the hole, and having a recess for the key.

The head is made of charcoal iron, or Bessemer metal, and is struck with a radius of two diameters, the top being truncated to receive a gun-metal socket, which is screwed to G.S. fuze-hole gauge, and attached to the head with solder. The head is fitted over a wooden block, and attached to the body of the shell by eight rivets; four pins are also inserted to prevent the head twisting; the holes for these twisting pins are slotted through to the bottom of the head. The rivets and twisting pins are covered with solder and brought up to correct outline.

Two holes are drilled in the head, into which tin cups are fitted to receive the claws of the extractor.

A disc of steel, with a hole screwed in the centre, is placed over the powder chamber, and rests on the shoulder formed to receive it.

The powder chamber is much larger than in the ordinary type of Shrapnel, it is lacquered and contains a bursting charge of 2 lbs. Pistol or F.G. powder which is inserted through the base.

A brass tube screwed at the lower end fits into the steel disc, whilst the upper end is fitted with a short tube screwed to receive a primer; the upper part of this tube is connected with the fuze socket by means of a conical tin tube.

The inside of the shell is lined with brown paper, and contains 540 mixed metal balls (14 to the lb.), the interstices being filled in with melted resin.

	lbs.	ozs.
Weight empty..	170	0
„ of gas-check..	6	2
„ bursting charge	2	0
„ fuze, time, sensitive.. ..	1	4
Total weight, about.. ..	180	0

Star Shell.

(Plate VIII.)

Mark IV shell is made of two hemispheres of Bessemer metal 0·259 inch thick, tinned all over, and fitted together with a lap-joint, the inside of each hemisphere being strengthened by a wrought-iron ring.

The upper hemisphere is fitted with a gun-metal socket for a wood time fuze, and the lower hemisphere is fitted inside with a wooden disc and ring, forming a bed on which the stars are packed. The two hemispheres are secured together by six screws and six twisting pins. In order to keep the fuze hole in an axial position when loading, a ring of yellow pine is glued and soldered on to the lower hemisphere.

The shell contains 31 stars, filled with improved magnesium light composition. Each star has a small hole in each end primed with quick-match and sulphur, to ensure their simultaneous ignition, and each is bound over the ends and several times round the body with soft copper wire to prevent its breaking up in the shell.

This shell will be fired with a 3½-lb. charge, and 15 seconds wood time fuze with special priming. As a rule it should be burst about

100 feet above plane, so as to ensure sufficient dispersion of the stars before reaching the ground.

The earlier Marks vary in the method of priming of the stars and the composition with which they are filled, also in having only 21 stars instead of 31.

Time of burning from 30 to 50 seconds, the bright stars burning out more quickly.

Average total weight 22 lbs.

A special range table is required for star shell, *vide* p. 40.

Case Shot.

(*Plate VIII.*)

The body is made of tinned sheet iron in three strips, jointed and soldered, the bottom is of sheet iron soldered to the sides which are turned over it; a ring of sheet iron is riveted on the base outside, and a disc of sheet iron laid on it loose, inside. The sides of the case are lined with six longitudinal sheet iron segments. The top is of sheet iron, fixed by turning over the notched end of the case and soldering. Two wrought-iron staples riveted to the top form an attachment for a wrought-iron handle.

The case contains 75 sand shot each weighing 8-oz., packed in with clay and sand.

Total weight about 74 lbs.

Gas Checks.

The rotation of the common and Shrapnel shells is effected by means of automatic gas-checks, the curved portion of the base of the shell being cast with 37 radial grooves, into which the inner surface of the gas-check is compressed by the pressure on firing; the gas-check is also at the same time firmly attached to the base of the shell by being compressed into the groove or neck round the locking rim at the rear end of the shell.

The gas-check is made with 24 projections round the circumference corresponding with the rifling grooves of the howitzer. It is suitable for either common or Shrapnel shell.

Bags, burster.

These are for holding the bursting charges of the common shell. There are two patterns, one for the iron shell and one for the steel. They are both of dowlas, with shalloon tips so as to allow the flash of the fuze to reach the bursting charge. The former has a double thickness of dowlas at the shoulder, the latter has the shoulder strengthened by collar cloth. They also differ in dimensions, so as to fit accurately inside their respective shells.

Instructions for Preparation of Shells.

Fixing Gas Checks.

Gas-checks are loaded for service independently, and become fixed to the shells when the gun is fired.

Filling Shell.

Common Shell.

Both iron and steel common shell are filled through the base, the bursting charge being contained in a bag.

Remove the base plug with the "wrench, base plug," the shell having been tilted on its point in a hollowed piece of wood and being retained in this position by means of the "holder shell, R.M.L. studless, 8-in."

Drop in three "bags, primer, filled, 7 drams."

Place the filling rod in the "bag, burster," and insert it into the shell, taking care not to force the end of the rod through the bag; carefully push the bag in until the neck only is in the plug hole, a portion being kept outside, as the whole bag must not be allowed to slip into the shell during the operation of filling; then withdraw the rod.

Weigh out the bursting charge in proportions of about 4 lb. P and 10 oz. F.G.

Drop in one portion of P. powder, pebble by pebble, then insert the funnel and pour in one portion of F.G. Then insert the filling rod, and lightly press and stir the powder all over, so as to set it well down into the shell.

Repeat the operation till the shell is completely filled.

Now tie up the neck of the bag with the twine which is attached and which may be shifted to its proper position, if necessary; cut off the end of the choke, and push it in, well down and to one side of the hole.

See that the plug hole is quite clean, lubricate the plug, and screw it home.

Shrapnel Shell.

These are filled through the base. First remove the plug from the fuze-hole and drop in the "primer, Shrapnel shell," and by means of the "driver, screw, Shrapnel, large," screw it firmly into the tube and replace the plug. Then turn the shell on its point and remove the base plug. Carefully weigh out the bursting-charge (Service Pistol, F.G., R.F.G., or R.F.G.^{2}) and pour it into the shell through the leather funnel, tapping the shell with a wooden mallet till the whole of the charge has been inserted. Then replace the base plug.

Star Shell.

These shells are issued filled—they are ready for the insertion of the fuze when the plug is removed.

When loading with star shell, the cartridge and shell should be rammed home simultaneously, making use of the sponge head for this purpose, as the recess in the rammer is liable to grip the head of the wood fuze. The sponge should be dry.

Fixing Plugs and Fuzes and Securing Shells.

When plugs or metal fuzes are screwed into shells, they will be lubricated with a mixture composed as follows :—

Luting, Mark II ..	..	..	100 parts by weight.
Luting oil	.. ..	..	17 „ „

A coat of paint of the same colour as the tip of the shell is to be applied over the junction of the G.S. fuze-hole plug and socket when the shell is filled.

Empty projectiles fitted with plugs and kept in exposed situations where the plugs are liable to become set fast by corrosion from the action of salt water, or otherwise, should have their plugs unscrewed once at least every six months, and the threads cleaned and relubricated as above.

Instances have occurred in which fuze-hole plugs of common shells have been so jammed in as to be immovable, in consequence of using the "Wrench, base plug." The "Key, fuze and plug, G.S.," the "Key, plug, G.S.," and the "Key, fuze, universal," are the only implements which should be used for screwing in the G.S. plug.

Distinguishing Marks.

Shrapnel shell will be painted with a red tip 1 inch deep.

Steel shell will have a white band $\frac{1}{2}$ inch wide painted round the head 1 inch from the top; in the case of Shrapnel it will be immediately below the red tip. C.S. is stamped on the base of cast steel projectiles.

Filled shell will be marked in red as follows :—

(*a*) A band $\frac{1}{2}$ inch wide round the head, $1\frac{1}{2}$ inch from the top; this will be $\frac{1}{2}$ inch below the red tip of Shrapnel shell or immediately below the white band of steel shell.

(*b*) The word "Bag," if one has been used.

(*c*) The monogram of the station, except when filled by R.A.

(*d*) The date of filling.

(*e*) A disc, 1 inch diameter, if shalloon primers have been inserted.

(*f*) The letter "P," $1\frac{1}{2}$ inch long, if filled with P. and F.G.

The size of the type, except the letter P, will be $\frac{3}{4}$ inch. Stencil plates will be made locally, except those for marking the red or white band or tip, which will be demanded, the exact nomenclature and numeral of the shell being stated on the demand.

Projectiles which are to be used for practice only will be plugged with wood and marked with a yellow band $\frac{1}{2}$ inch wide round the body, all other marks being obliterated, except the red and white rings and red tip, if present.

Shells which have been emptied will be marked on the head with the letter "E" in red paint, and also the monogram of the station.

Examination of Filled Shell.

The examination of filled shell will only be carried out by an Inspector of Warlike Stores. The general procedure is as follows :—

Common.

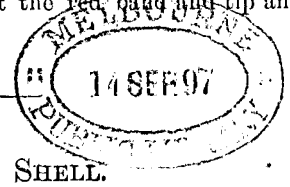
Unscrew the base plug by means of the "wrench, base plug."

Draw out the neck of the bag with the "Hook, G.S. wads," untie the twine, and examine the powder. If the powder is in a serviceable condition, add additional powder within the bag, if necessary, to fill the shell, then tie up the bag and proceed as directed above for filling shell. If the powder is caked from the effects of damp, the shell must be returned to store.

Shrapnel.

Remove the fuze-hole plug, unscrew the primer with the "driver, screw, Shrapnel, large," and lift out the primer with the "pincers, Shrapnel, primer." Turn the shell nose downwards, and allow a portion of the powder to run out. If the powder flows out freely and is serviceable, refill and insert a new primer, and replace the plug; the old primer will be tested. If the powder is caked from the effects of damp, &c., the primer and plug will be replaced, and steps taken for the exchange of the shell.

If the primer cannot be extracted, the shell will be plugged with wood and will have a yellow ring $\frac{1}{2}$ inch wide painted round the body, the other marks being obliterated, except the red band and tip and white ring, if present.



Storage of Filled Shell.

Instructions for the storage of filled shells in charge of the Royal Artillery will be found in the "Magazine Regulations."

Fuzes.

(*Plates* VIII to X.)

Direct action, No. 3, Marks I* and II.
Time, Sensitive, long. No. 23.
,, middle, No. 24.
Time, 15 seconds, M.L. special priming, No. 42, for use with star shell.

A proportion of direct action delay fuzes is allowed for this howitzer when in the siege train, but not when in movable armament.

Fuze, Percussion, Direct Action, No. 3, Mark II.

This fuze is intended to act on direct impact; it cannot be depended on to act on graze unless fired at angles of elevation of 10° and upwards.

It is made of gun-metal, turned all over, and screwed below the head to fit G.S. fuze hole. The interior is bored out at the lower end for the powder charge, and closed with a screw base plug. A recess in the upper part of the fuze is charged with detonating composition, and the holes communicating with the magazine are filled with powder priming. The fuze is fitted with a steel needle, passing through, and secured in, a copper suspending disc ·032 inch thick. The lower part of the fuze is filled with pistol powder. A gun-metal cap having a T-shaped slot cut out in each side to fit over the projecting pins in the head of the fuze, is secured over the top.

On striking any object, the suspending disc is driven in and the needle is forced against the detonating composition, thereby exploding the fuze.

Mark I* is the obsolete Mark I altered and is practically identical with Mark II. It was altered by fitting a stronger needle disc and a shorter needle.

Fuze, Time, Sensitive, Long, No. 23.

The fuze is made of gun-metal, turned all over, and screwed to suit G.S. fuze hole. The interior is bored out at the lower end for the powder charge, and screwed at the bottom to receive a base plug. The upper part of fuze is fitted in the interior with a lighting pellet, two retaining pellets, two spiral springs (to keep the retaining pellets hard against the lighting pellet) and a needle; an axial magazine is screwed in the centre of stem, and the upper part of fuze fitted with a composition ring (numbered from 1 to 60, reading to quarter units round the outside, and having three escape holes through the inner side), a dome, and cap. The lower part of body of fuze is filled with powder, covered with a disc of shalloon, and the bottom closed with a screw plug of gun-metal having a hole through the centre, and dished out at the bottom; the hole is closed with a brass disc spun in. The fuze has two safety pins, one passing through each retaining pellet, and each having a loop of tarred line attached.

At the moment of loading the safety pins are withdrawn, and when the shell is fired the rotation causes the retaining pellets to fly out, releasing the lighting pellet which strikes the needle, the flash igniting the axial magazine communicating with the composition ring which burns to the time set, and then ignites the powder in the diagonal hole leading to the magazine and fires the fuze.

Time of burning at rest .. .. 29·2 to 31·5 secs.

Fuze, Time, Sensitive, Middle, No. 24.

This fuze differs in dimensions only from No. 23 described above, and burns half the time. The composition ring is numbered from 1 to 30, and reads to quarter units.

Time of burning at rest .. .. 14·6 to 15·8 secs.

Fuze, Time 15 seconds, M.L., Special Priming, No. 42, Mark I.

The fuze is made of beech-wood turned to a cone of 1 in 9·375 inches. The interior is bored out to within ·25 inch of the bottom, and fitted with a brown paper cylinder containing fuze composition and pressed mealed powder, and the top closed with a screw plug of gun-metal, having a copper pin projecting to hold the bights of the quick-match priming. Two escape holes are bored through the side of head through which the quick-match priming is passed, wound round the head and covered with strands of gun-cotton priming, and the head covered with a cap of fine white paper. Six rows of side holes are bored at right angles to the axis of the fuze, and six channels are bored in line with the side holes and parallel to the axis; the channels are filled with pistol powder and connected at the base by quick-match; the side holes are filled with pistol powder pressed, and covered with fine paper.

An index paper graduated to 30, and showing by yellow dots the position of the side holes, is passed round the body of the fuze, and the surface varnished.

A copper band covered with tape is secured round the head of the fuze. The head is painted red, and the end of the band white.

Time of burning at rest .. .. 14·6 to 16·5 secs.

Preparing and Fixing Fuzes.

Direct Action.

The fuze is screwed into the shell by the "key, fuze, universal," or the "key, fuze, or plug, G.S."

Remove the cap after entering the shell into the muzzle. No other preparation is required.

Long and Middle Sensitive Time.

These fuzes are screwed into the shell, before being set, by the "key, fuze, universal," using the semicircular arm with the small projection on it which fits into a hole in the body of the fuze. To set, loosen the nut with the "key, fuze, universal," and turn round the composition ring, with which the dome will also move, until the required graduation on the ring is opposite to the arrow head on the

body, and clamp the nut. At the moment of loading withdraw both the safety-pins, which will be found protruding below the composition ring.

15 seconds, with Special Priming.

These fuzes are fixed in the fuze-hole by screwing the fuze round by hand until it is held firmly. They are "uncapped" by taking hold of the small end (coloured white) of the band, which is left exposed, and unwinding from left to right smartly, so as to thoroughly detach the band from the head of the fuze, and to leave the priming fully exposed. The extra priming of dry guncotton should not be disturbed. The uncapping must not be done until the shell is placed in the muzzle of the gun.

CHARGES.

The range tables are calculated for the following charges of R.L.G,[2] 11½, 10½, 9½, 8½, 7½, 7, 6½, 5½, 4½ and 3½ lbs., but filled cartridges are only issued containing 11½, 7, and 3½ lbs.

There are two Marks of the 11½ lb. cartridge; Mark I was rather longer than the chamber of the howitzer, which prevented the shell from always being rammed home to the same point. This has been remedied in Mark II.

Cartridge.	Maximum Length.	Maximum Diameter.	Number of hoops.
	inches.	inches.	
11½ lbs. { Mark I ...	9·0	7·3	4
11½ lbs. { Mark II ...	7·7	7·76	4
7 „	6·5	6·7	3
3½ „	4·5	6·1	1

The other charges must be made up by altering these as required.

All the cartridges are made of No. 1 Class silk cloth, hooped with ·35-inch silk braid, and choked with silk twist.

A blank charge has been approved for use on field days, &c., when this howitzer forms part of the movable armament. This charge consists of 3 lbs. L.G. and is contained in the 3 lb. empty service cartridge of the 8-inch, 46 cwt., howitzer, which will be re-marked, when filled, as necessary.

Drill Cartridge.

A dummy cartridge is issued for drill purposes, made of wood, covered with raw hide, and of about the same dimensions and weight as the 11½-lb. Mark I cartridge.

Directions for Making up Cartridges.

Care will be taken to see that the empty cartridges are thoroughly dried before being filled, and the proper charge will be carefully weighed out, and inserted in the cartridge by means of the "funnel, copper, cartridge."

The cartridges are choked as follows:—The mouth is drawn together into serveral plaits with a magazine needle threaded with two strands of silk twist; after drawing together the mouth of the cartridge, three turns will be taken round the plaits, and the choke thus formed will be further secured by passing the needle three times through it alternately above and below the turns, thereby stitching down the turns round the choke at two points equidistant from each other.

The cartridges will be made up to their proper lengths and diameters by means of the hoops. The operation is performed as follows:—Draw the braid through the silk cloth until the knot of the loop comes home to the cartridge; the single end being passed through the loop from underneath, pass it to one side of and under the loop, then draw the hoop tight, and keep it so by placing the forefinger of the left hand firmly on the loop; bring the running end between itself and the loop, and draw tight the single bend thus formed, *taking care that the bend bites on the loop and not on the single end*, otherwise the knot will slip. The maintenance of the proper form of the cartridge depends on the hooping being thus secured.

The chokes of the 3½-lb, and 7-lb. cartridges are not to be cut off, so as to allow of more powder being added afterwards, if it is required to bring the cartridge up to any of the intermediate weights, and also to check the tendency of these small cartridges to turn over in loading, the choke being of such a length that when the rammer, in loading, is pressed on the surplus material, the choke is prevented from turning up under the vent.

In re-making up cartridges the charge should always be weighed with the greatest care.

Marking Filled Cartridges.

There are four patterns of empty cartridges, which are marked for 11½ lb., Marks I or II, 7 lb., or 3½ lb. When filled with any other charge, they will have the original marking crossed out, and the new one inserted.

Cartridges are marked with the nature of the powder they contain. A record of powder used in all cartridges, with maker's name, lot and date of filling, will be marked on the package, and will be kept in a book for reference.

All cartridges issued from store filled will have the initial or monogram of the station at which they are filled stamped on the bottom end. The cartridges filled by the Royal Artillery will be distinguished by having no initial letter or monogram stamped on them. This order does not apply to cartridges filled by working parties of the Royal Artillery for the Ordnance Store Department.

The initials and monograms used at various stations are given in the Magazine Regulations.

Finished Cartridges.

All cartridges will be very carefully examined and gauged as to length and diameter previous to packing. They will be packed in metal-lined cases as follows :—

	Whole.	Half.
$11\frac{1}{2}$ lbs.	8	.. 3
7 „	12	.. 6
$3\frac{1}{2}$ „	32	.. 14

When filled, the case is closed by covering the side of the bung all round flush to the top and bottom rim with cold luting, pressing it well home, and filling up the recess round the bung with cold luting, and smoothing it down with the thumb. The wooden lid is then closed, and the two gun-metal bolts screwed down alternately, giving not more than one turn at a time to each, so as not to strain the bolts or hinges.

The marking will be in such a position that the nature of the contents can be seen when the packages are stacked; the following particulars should be given :—

(*a*) Numeral and designation of cartridges.
(*b*) Number of cartridges.
(*c*) Manufacturer, date and lot of powder.
(*d*) Monogram of station and date of packing.
(*e*) Tare weight of case.
(*f*) Gross „ „

Tubes.

The *Tube, friction, copper, long, Mark II,* consists of a copper tube, 5 inches long and ·2 inch in diameter, lacquered inside, driven with mealed powder, and pierced with a central hole. The top is closed with shellac putty and varnished paper, and the bottom by a disc of varnished paper. A hole is bored through one side of the tube, having its centre about ·25 inch below the top, and over this hole is secured a copper nib-piece, containing a roughened copper friction bar. This is smeared with a detonating composition of chlorate of potash, sulphur, and sulphide of antimony, and the nib-piece is pinched down upon the friction bar, the projecting part of which has a vertical eye, into which the hook of the lanyard fits. On pulling the lanyard the friction bar is drawn out, igniting the composition and firing the tube; the central hole gives a passage for the flash, and causes instantaneous action. The gas from the exploded cartridge drives the tube out of the vent.

The *Tube, friction, copper, solid drawn, Mark II,* is made of solid drawn copper, and has a solid head; it is filled with pistol powder, and the bottom is closed by a brass ball over which is a cork plug, secured by shellac. The length is 2·1 inches. The arrangement of the friction bar is similar to that of the long tube described above, but the nib-piece is solid drawn and projects right through the tube, and has a small hole bored in it to allow the flash from the friction composition to reach the powder in the tube.

Mark I solid drawn had not the brass ball, and had a nib-piece similar to that of the long tube.

Drill.

Travelling Carriage fitted with Hydraulic Buffer.

The detachment consists of 10 Nos., and falls in two deep. It is told off, marched into the battery, and halted in line, facing the parapet and to the left rear of the platform. It is now in the position of "detachment rear."

To Take Post under Cover.*

Officer.	*No. 1.*
Take post under cover.	*Double March.*†

The numbers double to their places as follows:—2 and 4 on the right of the gun, 3 and 5 on the left of the gun close to the parapet and facing the rear, 2 and 3 next the muzzle. No. 1 follows in rear of the detachment, keeping under cover as much as possible; 6 and 8 going to the cartridge store; 7, 9, and 10 to the shell store.

General Duties.‡

No. 1 commands, directs or superintends boring and firing of fuzes, assists to run up, records the readings of sights and clinometer, and lays.

No. 2 searches, assists to lift projectile, rams home, runs up, traverses and sponges.

No. 3 loads, assists to raise projectile, uncaps or removes safety pin from fuze when in the bore, rams home, runs up and traverses.

No. 4 attends to sidearms, and supplies them to 2, runs up and elevates.

No. 5 supplies gas-checks to 3, runs up, makes ready, fires and attends to vent.

No. 6 supplies 3 with cartridges.

No. 7 attends to fuzes, brings up projectile in bearer and lifts it to the muzzle.

No. 8 attends to magazine or cartridge stores, and serves out cartridges.

No. 9 assists 7 in all his duties, and returns empty bearer.

No. 10 attends to shell store, and issues shells, tubes, and fuzes.

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* If the howitzer is not behind a parapet and the word of command is "*Take post at the howitzer,*" 2 and 3 halt in line with the front of the wheels, 4 and 5 with the rear of the wheels, No. 1 in rear of the howitzer, 6, 7, 8, 9, and 10 at the limber.

† All words of command given by the No. 1 should be prefaced by the number of his gun.

‡ When from any cause the No. 1 is not the gun layer, the duties of Nos. 1 and 5 will be: No. 1 commands, directs or superintends the boring and firing of fuzes, supplies 3 with automatic gas-check, runs up, makes ready, fires and attends to vent; No. 5 assists to run up, records the readings of sights and clinometer, and lays.

To Prepare for Action.

Officer.	*No. 1.*
Prepare for action.	*Prepare for action.* *Examine gun.*

"*Prepare for action.*"—The stores are brought up as follows:—

No. 1, handspike and sights, clinometer, piece of chalk, and 50 feet tape.

No. 2, large scotch, handspike, and assists 4 with side arms.

No. 3, large scotch, handspike, 2 banderols, removes the tampeon from the muzzle.

No. 4, handspike, elevating wheel, side arms, and support for head of side arms.

No. 5, handspike, tubes in pocket, lanyard, pricker, and vent server.

No. 6, two cartridge cases, which he leaves at the cartridge store, bucket filled, and brush. (For drill purposes two drill cartridges.)

No. 7, fuzes, and fuze and shell implements. He obtains the fuze-boxes from 10, having ascertained from No. 1 the fuzes required; and satisfies himself as to the correctness of fuzes and fuze implements.

No. 8 prepares to issue cartridges.

No. 9 brings up a shell bearer and brush; also gas-checks in box, with lid unscrewed.

No. 10, hammer and file for removing burrs on gas-checks, &c. He goes to the shell store and prepares to issue shells, friction tubes, and fuzes. He examines the shells carefully, cleans them if necessary, and loosens the fuze-hole plugs of shells that will be first issued.

The stores having been brought up, the No. 1 will satisfy himself that the fore-sights fit properly on the howitzer and the horizontal bars of the sights work easily;* he receives the reports from the Nos. responsible, of any irregularity or deficiency in connection with the howitzer, ammunition, or stores; he will ascertain that the buffer contains the correct amount of oil, and chalk on the piece the necessary headings for the elevation, deflection, auxiliary mark, and for the readings of the sliding leaves when clamped on the auxiliary mark. He will see the platforms swept, and sand bags arranged, if necessary, for the loading number to stand on.

The sponge and rammer are laid on the ground clear of the platform, to the right of the howitzer, and parallel to it, heads to the rear, resting on the support supplied by 4, rammer nearest the howitzer. The wadhook and extractor are laid on the ground clear of the howitzer.

The sponge bucket is placed near the sponge head.

The handspikes are laid down, two on each side of the howitzer close to the carriage, points to the front, bevelled side uppermost, those of 2 and 3 outside, and about two feet in advance of those of 4 and 5, No. 1's handspike in rear of the platform.

No. 3 examines the bore to see that the grooves are free from grit, and if necessary gives "*Sponge out.*"

* Only one set of sights are placed in the piece: usually the right side ones.

No. 4 ascertains that the elevating gear is in working order (should the elevating arc have been detached from the carriage he brings it up and adjusts it).

No. 5 straps the tube pocket round his waist on the right side, coils up the lanyard and passes the bight of it through the tube pocket strap; examines the vent server, and places it in the vent, the loop of the vent server lanyard over one of the sights; he fills his tube pocket with friction tubes which he procures from 10, and places the pricker in the loop on the carriage and sees that the automatic gas-checks are placed in a convenient position.

N.B.—Should the stores be on the howitzer, they are unstrapped and laid down as above detailed.

"*Examine gun.*"—No. 5 drifts the vent, replaces the pricker in the pocket and the vent server. 2 supplies himself with the wadhook, searches the howitzer after the pricker has been withdrawn, and replaces the wadhook. 4 attends to the elevating wheel to bring the howitzer into a convenient position for loading.

The howitzer should be at about 5° of elevation to facilitate uniform ramming home, and a chalk mark made on the piece in line with the horns of the travelling trunnion holes, so that for future rounds the piece may be readily got into the same position. No. 1 will clamp his sights with the sliding leaves at the 4th graduation, and at zero of the deflection scale.

To Load.

Officer.	*No. 1*
Range.....yards (or elevation) *Deflection.....right or left.* *With.....load.**	*With.....load*

"*Load.*"—No. 1 gives 7 the nature of shell and fuze required. He places himself in a convenient position, near the muzzle, whence he can watch the loading and observe, by the mark on the rammer, if the shell is home. He records elevation and deflection ordered.

No. 2 places himself in a convenient position for ramming home. He places his left foot in line with, and about 12 inches from the muzzle, steps to his right with his right foot, and looking to his left rear, takes the rammer in a horizontal position from 4, right hand about the centre, back down, left as near the head as possible, back up. The rammer stave should be marked so as to show when the round is "home," and a second mark should be made, one foot nearer the head. As soon as the cartridge is put in, he rams it home; he then springs the rammer and rests it inside the wheel against the carriage. After the gas-check has been placed in the bore, he assists to place the projectile in the bore, and resuming the rammer he with 3 rams home hand over hand, till the first mark comes against the muzzle. 2 and 3 then halt and reach out as far down the stave as they can, and wait for the word "*Home*" from No. 1. On that word, 2 and 3 ram home together, throwing all their weight back on the rammer, and keeping their arms straight. 2 then springs the rammer, steps out, replaces it and goes under cover.

* If the command is "*With shell load*" common shell and percussion fuze is implied.

No. 3 takes the cartridge from the cartridge case with his left hand, moves up and places it in the bore, being careful that the seam of the cartridge does not come under the vent; should the choke of the cartridge be long enough the head of the rammer should be pressed on the surplus material in ramming home to prevent the cartridge turning over. When the cartridge has been rammed home, he receives a gas-check from 5, and places it in the bore, painted side to the rear; he then assists 7 and 9 to lift the projectile and place it in the bore, withdraws the safety pin, or uncaps the fuze, places himself in a corresponding position to 2 and assists him to ram home; when the projectile is home he quits the stave and goes under cover.

No. 4 doubles out, halts in line with the rammer head, turns to his left, picks up the stave with his right hand back under, 6 inches from the head, turns three quarters left about, and in doing so lifts the rammer over his head, allowing the end of the stave to rest on the ground. His left hand meets the stave close to the head, his right hand is slipped up the stave about two feet. He then moves towards the muzzle, and places the rammer in a convenient position for 2 to lay hold of, and goes under cover.

No. 5 hands a gas-check to 3.

No. 6 brings up a cartridge in a case and places it on the ground on 3's right front, uncovers it, and, as soon as 3 has withdrawn the cartridge, takes the case back to the cartridge store.

Nos. 7 and 9 bring up projectile in bearer, having fixed the fuze according to No. 1's directions, and assisted by 2 and 3 place it in the bore. 9 removes the empty bearer.

No. 8 issues a cartridge to 6.

No. 10 issues a shell to 7 and 9.

To Run up.

Directly the howitzer is loaded No. 1 gives "*Run up*," and applies his handspike between the brackets of the trail to guide the howitzer, so that the right wheel may touch the pivot.

Nos. 2, 3, 4, 5, take up their handspikes; 2 and 3 unscotch and apply theirs horizontally over the spokes of the wheels in front, and under the bracket, close to the breast, and bear down; 4 and 5 use theirs as levers of the second order under the rear part of the wheels. All four numbers face to the rear.

When the howitzer is run up, No. 1 gives "*Halt*," slides his handspike to the rear clear of the recoil, and the numbers withdraw their handspikes and go under cover. The line of fire is now obtained.

Officer.	*No.* 1.
Pick up the line of fire from the front (or rear).	*Pick up line of fire.*

(*a.*) From the front—as in Siege Artillery Drill, No. 4 holding up a banderol or wadhook at the howitzer close to the sliding leaf of the foresight, and 2 and 3 taking banderols to the front, 3 being nearest to the piece.

(*b.*) From the rear—No. 4 holds up a banderol as above, 2 doubles at least 40 or 50 yards (if possible) to the rear with a banderol, and under the superintendence of the Officer, plants it in line with No. 4's banderol and the target.

As soon as the banderol is placed in rear in the line of fire, the numbers double under cover.

To Lay the Howitzer.

Officer.	*No. 1.*
	Take post to lay.

No. 1 places himself inside the wheel in front of the foresight ready to lay back. 2 and 3 pick up their handspikes, and go to the end of the trail facing the front ready to traverse. 4 goes to the elevating wheel. 5 prepares a tube. No. 1 lays back on the banderol.

Officer.	*No. 1.*
	Trail right. *Trail left.* *Halt.* *Under cover.*

At "*Trail right*," 3 heaves over the trail, at "*Trail left*," 2, till the word "*Halt.*"

When the piece is approximately in the line of fire, and it is necessary to adjust the trail plank, 2 and 3 place their handspikes under the trail eye and raise it, while No. 1 and 5 shift the plank. The proper position for the plank is under the centre of the trail, the end projecting about 6 inches in front of the trail. The plank should be in the line of recoil.

When it is necessary to adjust the wheel plates, all the numbers will stand round the trail and lift, except No. 1, who arranges the large coin, so that, resting on its broad end under the axle-tree, it may form a fulcrum when the trail is borne down, and lift the wheel while the wheel plate is being adjusted. The proper position for the wheel plate is with its front edge about in line with the rear edge of the third plank of the platform from the front and parallel with the line of recoil.

The piece is accurately laid for line after the trail plank and wheel plates have been adjusted, and on the word "*Under Cover*," 2 and 3 lay down their handspikes and go under cover.

No. 1 will then pick up an auxiliary mark, as explained on page 4, note the details on the piece, take the inclination of the trunnions with clinometer on the cascable plane, and report it to the Group Officer.

The piece is then laid with the deflection ordered, on the auxiliary mark, and for elevation, by clinometer.

Officer.	*No. 1.*
	Elevate. *Depress.* *Halt.* *Under Cover.*

At "*Elevate*" or "*Depress*," 4 turns the wheel in the required direction till the word "*Halt*" is given. He goes under cover on

completion of the laying. No. 1 removes the clinometer and places it in its box, and takes out the tangent sight, which he holds in his hand, and should no order to fire be given goes under cover.

If it is necessary to run back; at "*Run back*," 2 and 3 apply their handspikes in front of the wheels using them as levers of the second order, 4 and 5 take a purchase with theirs over the most horizontal spokes in rear and under the brackets; the whole facing the rear.* As soon as the piece is run back 2 and 3 scotch the wheels with large scotches.

To Make Ready and Fire.

Officer.	*No. 1.*
Fire No.———Gun.	*No.———Ready.* *No.———Fire.*

No. 1 gives "*Ready*;" 5 presses the tube into the vent with his right thumb, steps clear of the recoil, and holding the lanyard in his left hand, stretches it taut, keeping his hand level with the vent, facing the front, fore-arm across the body.

If the numbers are under cover, 2, 3, and 4 take an oblique pace outwards and face the muzzle; if not under cover, they take up this position on laying down their handspikes.

At "*Fire*," 5 slews his body to the left, and thus fires the howitzer: he then drifts the vent, replaces the vent server, and goes under cover.

Directly the gun is fired 2 and 3 scotch up the wheels, 4 steps in, and brings the gun into the proper position for loading, No. 2 supplies himself with the sponge, and sponges out the howitzer, as soon as the vent server is in the vent; his position is similar to that for ramming home. He holds the sponge in the left hand, back down, right hand back up, brings it in a line with the axis of the gun, enters the head into the bore, being careful to observe that the vent server is in the vent, slides his hands along the stave to his right as far as he can reach, sends the sponge up the bore, slides his hands out again and forces the sponge hard home, gives it two half turns, pressing it against the bottom of the bore, withdraws the sponge, hand over hand, turning it from him, cleaning the bore well. When the sponge arrives near the muzzle, he jerks it out; his hands should then be in the position they were in when he introduced the sponge into the bore. He then replaces the sponge.

If the order to load has been given, the numbers proceed as previously detailed.

If no order has been given, 2 goes under cover as soon as he has replaced the sponge.

No. 1 does not give "*Load*" until 2 has finished sponging.

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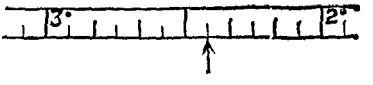
* If a holdfast can be arranged in rear of the howitzer, running back can be more simply and quickly effected with a tackle and two selvagees.

Instructions for using the Clinometer.

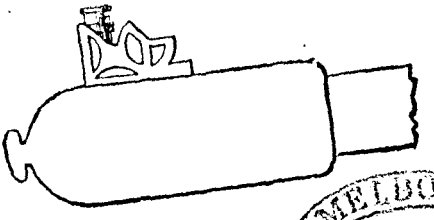
To read the angles marked on the drum.—The brass drum is marked in degrees, commencing at 0° on the top to 45° at the bottom. Each degree is sub-divided into 12 parts, each small division, therefore, represents an angle of 5 minutes.

The scale is read from right to left, thus,—

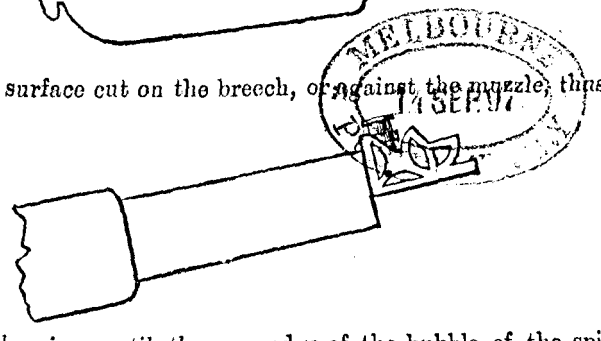


the reading opposite the arrow would indicate an angle of 2° 25′.

To lay the howitzer at any angle up to 45°.—Unscrew the drum until the ⅄ points to the elevation required, place the clinometer, thus—



on the plane surface cut on the breech, or against the muzzle, thus—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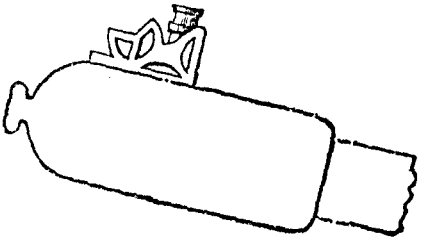
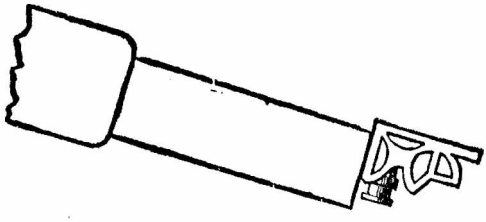
and elevate the piece until the rear edge of the bubble of the spirit level is tangential to the rear line on the glass.

For angles of depression.—Proceed as above, but reverse the direction of the instrument, placing it thus on the breech of the howitzer—



and thus on the muzzle—



Range Tables.

(Based on practice of July, September, and December, 1879.)

Projectiles, common, and Shrapnel shells, fitted with automatic gas-checks weight, 180 lbs.

Charge, 11½ lb. R.L.G.[2] Muzzle velocity, 956 f.s.

Range.	Drift, right.	Elevation.	Deflection, left.	Angle of descent.	Remaining velocity.	Five minutes, elevation increases or decreases the range by	Five minutes will alter point of impact, vertically or laterally, at each range	50 per cent. of rounds should fall within			Time of flight.
								Length.	Breadth.	Height.	
yds.	yds.	° ′	° ′	° ′	f. s.	yards.	yards.	yards.	yards.	yards.	secs.
300		0 44	...	...	935	25·0	0·43	...	...	...	...
400		1 4	...	...	928	25·0	0·58	...	...	...	...
500	0·3	1 24	0 2	1 38	921	25·0	0·72	7·0	0·14	0·20	1·6
600	0·4	1 44	0 3	1 56	914	25·0	0·87	8·4	0·18	0·31	1·9
700	0·6	2 4	0 3	2 16	907	25·0	1·01	9·8	0·21	0·43	2·3
800	0·8	2 24	0 3	2 36	900	25·0	1·16	11·2	0·25	0·55	2·6
900	1·0	2 44	0 4	2 56	894	25·0	1·31	12·5	0·28	0·67	3·0
1,000	1·3	3 4	0 5	3 17	888	25·0	1·45	13·8	0·32	0·79	3·3
1,100	1·6	3 24	0 5	3 38	882	25·0	1·60	15·1	0·36	1·00	3·7
1,200	1·9	3 44	0 6	4 0	876	25·0	1·74	16·4	0·40	1·21	4·0
1,300	2·3	4 4	0 7	4 24	870	25·0	1·89	17·7	0·44	1·42	4·4
1,400	2·8	4 24	0 7	4 48	864	23·8	2·03	18·9	0·48	1·63	4·7
1,500	3·3	4 45	0 8	5 12	858	23·8	2·18	20·1	0·52	1·84	5·1
1,600	3·8	5 6	0 9	5 36	852	23·8	2·32	21·3	0·56	2·14	5·4
1,700	4·4	5 27	0 10	6 0	846	23·8	2·47	22·5	0·60	2·44	5·8
1,800	5·0	5 48	0 10	6 25	840	23·8	2·61	23·7	0·64	2·74	6·1
1,900	5·6	6 9	0 10	6 50	834	23·8	2·76	24·9	0·68	3·05	6·5
2,000	6·3	6 30	0 11	7 16	829	23·8	2·91	26·1	0·72	3·36	6·8
2,100	7·1	6 51	0 11	7 41	824	23·8	3·05	27·3	0·77	3·78	7·2
2,200	7·9	7 12	0 12	8 12	819	23·8	3·20	28·5	0·82	4·21	7·5
2,300	8·7	7 33	0 13	8 42	814	23·8	3·34	29·7	0·87	4·64	7·9
2,400	9·5	7 54	0 13	9 12	809	22·7	3·49	30·9	0·92	5·07	8·2
2,500	10·4	8 16	0 14	9 42	804	22·7	3·63	32·1	0·98	5·50	8·6
2,600	11·3	8 38	0 15	10 12	799	21·7	3·78	33·3	1·04	6·08	9·0
2,700	12·3	9 1	0 16	10 42	794	21·7	3·92	34·5	1·10	6·66	9·4
2,800	13·4	9 24	0 16	11 14	789	20·8	4·07	35·7	1·17	7·25	9·8
2,900	14·5	9 48	0 17	11 48	784	20·8	4·21	36·9	1·25	7·84	10·2
3,000	15·7	10 12	0 18	12 24	779	19·2	4·36	38·0	1·33	8·43	10·6
3,100	17·0	10 38	0 19	13 0	775	19·2	4·51	39·1	1·41	9·14	11·0
3,200	18·5	11 4	0 20	13 36	771	19·2	4·65	40·2	1·49	9·85	11·4
3,300	20·1	11 30	0 21	14 12	767	19·2	4·80	41·3	1·57	10·56	11·8
3,400	21·8	11 56	0 22	14 48	763	17·8	4·94	42·4	1·66	11·28	12·2
3,500	23·6	12 24	0 23	15 26	759	17·8	5·09	43·5	1·75	12·00	12·6
3,600	25·5	12 52	0 24	16 6	755	17·8	5·23	44·6	1·85	12·96	13·0
3,700	27·5	13 20	0 25	16 48	751	17·8	5·38	45·7	2·00	13·92	13·4
3,800	29·6	13 48	0 26	17 13	747	16·6	5·52	46·7	2·15	14·88	13·8
3,900	31·8	14 18	0 28	18 14	745	16·6	5·67	47·7	2·30	15·84	14·2
4,000	34·0	14 48	0 29	19 0	739	16·6	5·81	48·6	2·45	16·80	14·7
4,100	36·4	15 18	0 30	19 48	735	16·6	5·96	49·5	2·60	17·96	15·2
4,200	39·0	15 48	0 31	20 36	731	16·6	6·11	50·4	2·80	19·12	15·7
4,300	42·0	16 18	0 33	21 24	727	15·6	6·25	51·3	3·00	21·28	16·2
4,400	45·2	16 50	0 35	22 12	723	15·6	6·40	52·1	3·20	...	16·7
4,500	48·5	17 22	0 37	23 2	720	14·7	6·54	52·9	3·40	...	17·2
4,600	51·5	17 56	0 38	23 54	717	14·7	6·69	53·7	3·35	...	17·7
4,700	55·0	18 30	0 40	24 48	715	13·9	6·84	54·5	3·90	...	18·2
4,800	59·0	19 6	0 42	25 42	713	13·9	6·98	55·3	4·15	...	18·7
4,900	63·0	19 42	0 44	26 36	711	13·9	7·13	56·1	4·40	...	19·2
5,000	67·0	20 18	0 46	27 36	709	13·1	7·27	56·9	4·65	...	19·7
5,100	72·0	20 56	0 48	28 40	708	12·5	7·42	57·7	4·92	...	20·2
5,200	77·0	21 36	0 50	29 46	707	11·9	7·56	58·5	5·19	...	20·7
5,300	82·0	22 18	0 53	30 54	706	11·9	7·71	59·3	5·46	...	21·3
5,400	87·5	23 0	0 55	32 7	705	11·3	7·85	60·1	5·73	...	21·9
5,500	93·0	23 44	0 58	33 24	704	11·3	8·00	60·9	6·00	...	22·5
5,600	99·0	24 28	1 0	34 44	703	11·3	8·14	61·6	6·27	...	23·1
5,700	105·0	25 12	1 3	36 4	704	10·4	8·29	62·3	6·54	...	23·7
5,800	111·5	26 0	1 6	37 24	705	10·0	8·43	63·0	6·82	...	24·3
5,900	118·0	26 50	1 8	38 48	706	9·6	8·58	63·7	7·10	...	25·0
6,000	124·5	27 42	1 11	40 12	707	9·2	8·73	64·4	7·40	...	25·7
6,100	131·0	28 36	1 13	41 36	708	9·2	8·87	65·1	7·70	...	26·4
6,200	137·5	29 30	1 16	43 0	709	9·2	9·02	65·8	8·00	...	27·1
6,300	144·0	30 24	1 18	44 21	710	8·9	9·16	66·4	8·35	...	27·9

Charge, 10½ b. R.L.G.[1] Muzzle velocity, 920 f.s.

Range.	Drift, right.	Elevation.	Deflection, left.	Angle of descent.	Remaining velocity.	Five minutes' elevation increases or decreases the range by	Five minutes will alter point of impact, vertically or laterally, at each range	50 per cent. of rounds should fall within			Time of flight.
								Length.	Breadth.	Height.	
yards.	yards.	° ′	° ′	° ′	f.s.	yards.	yards.	yards.	yards.	yards.	secs.
300	...	0 46	...	...	899	23·8	0·43	...	...	...	...
400	...	1 7	...	...	893	23·8	0·58	...	...	...	...
500	0·3	1 28	0 2	1 48	887	22·7	0·72	6·6	0·17	0·20	1·6
600	0·5	1 50	0 3	2 12	881	21·7	0·87	7·9	0·21	0·33	1·9
700	0·7	2 13	0 3	2 36	875	21·7	1·01	9·2	0·25	0·46	2·3
800	0·9	2 36	0 4	3 0	869	20·8	1·16	10·5	0·29	0·59	2·6
900	1·2	3 0	0 5	3 24	863	20·8	1·31	11·8	0·33	0·73	3·0
1,000	1·5	3 24	0 6	3 48	857	20·8	1·45	13·1	0·37	0·87	3·3
1,100	1·9	3 48	0 6	4 12	851	20·8	1·60	14·3	0·41	1·09	3·7
1,200	2·3	4 12	0 7	4 36	845	20·8	1·74	15·6	0·45	1·31	4·1
1,300	2·7	4 36	0 7	5 0	839	20·8	1·89	16·7	0·49	1·53	4·5
1,400	3·2	5 0	0 8	5 27	834	20·8	2·03	17·9	0·53	1·75	4·9
1,500	3·8	5 24	0 9	5 54	829	20·8	2·18	19·1	0·57	1·98	5·2
1,600	4·5	5 48	0 10	6 21	823	20·8	2·32	20·3	0·62	2·31	5·6
1,700	5·2	6 12	0 11	6 48	817	20·8	2·47	21·5	0·67	2·64	5·9
1,800	5·9	6 36	0 11	7 18	812	20·8	2·61	22·7	0·72	2·97	6·3
1,900	6·7	7 0	0 12	7 48	807	20·8	2·76	23·9	0·77	3·30	6·7
2,000	7·6	7 24	0 13	8 18	802	20·8	2·91	25·0	0·82	3·64	7·1
2,100	8·5	7 48	0 14	8 48	797	20·8	3·05	26·1	0·87	4·09	7·5
2,200	9·5	8 12	0 15	9 18	792	20·8	3·20	27·2	0·93	4·54	7·9
2,300	10·5	8 36	0 16	9 51	787	20·8	3·34	28·3	0·99	4·99	8·3
2,400	11·5	9 0	0 17	10 24	782	20·8	3·49	29·4	1·05	5·44	8·7
2,500	12·7	9 24	0 18	10 57	777	20·8	3·63	30·5	1·12	5·90	9·1
2,600	13·9	9 48	0 18	11 30	772	20·8	3·78	31·6	1·19	6·49	9·5
2,700	15·2	10 12	0 19	12 3	767	20·8	3·92	32 7	1·26	7·08	9·9
2,800	16·5	10 36	0 20	12 36	762	20·8	4 07	33·8	1·34	7·68	10·3
2,900	18·0	11 0	0 21	13 12	758	19·2	4·21	34·9	1·42	8·28	10·7
3 000	19·5	11 26	0 22	13 48	754	17·8	4·36	36·0	1·51	8·88	11·1
3,100	21·0	11 54	0 23	14 24	750	16·6	4·51	37·1	1·60	9·63	11·5
3,200	22·5	12 24	0 24	15 0	746	16·6	4·65	38·1	1·70	10·38	11·9
3,300	24·0	12 54	0 25	15 36	742	16·6	4·80	39·1	1·80	11·13	12·4
3,400	25·5	13 24	0 26	16 18	738	16·1	4·94	40·1	1·91	11·88	12·9
3,500	27·5	13 55	0 27	17 0	734	15·6	5·09	41·1	2·02	12·63	13·4
3,600	29·5	14 27	0 28	17 42	730	14·7	5·23	42·1	2·15	13·62	13·9
3,700	31·5	15 1	0 29	18 27	726	14·3	5·38	43·1	2·28	14·61	14·4
3,800	33·5	15 36	0 30	19 12	722	13·9	5·52	44·1	2·42	15·60	14·9
3,900	36·0	16 12	0 32	20 0	718	13·9	5·67	45·1	2·56	16·60	15·4
4,000	38·5	16 48	0 33	20 48	714	13·9	5·81	46·1	2·70	17·60	15·9
4,100	41·0	17 24	0 34	21 36	710	13·9	5·96	47·1	2·85	18·86	16·4
4,200	43·5	18 0	0 36	22 24	707	13·9	6·11	48·0	3·01	20·12	16·9
4,300	46·5	18 38	0 37	23 18	704	13·9	6·25	48·9	3·18	...	17·4
4,400	49·5	19 12	0 39	24 12	701	13·9	6·40	49·8	3·36	...	17·9
4,500	52·2	19 48	0 40	25 6	698	13·9	6·54	50·7	3·55	...	18·5
4,600	55·3	20 4	0 41	26 0	695	13·1	6·69	51·6	3·75	...	19·1
4,700	59·0	21 2	0 43	26 54	692	13·1	6·84	52·5	3·89	...	19·7
4,800	63·0	21 40	0 45	27 54	689	12·5	6·98	53·4	4·23	...	20·3
4,900	67·0	22 20	0 47	28 54	686	12·5	7·13	54·3	4·48	...	20·9
5,000	71·0	23 0	0 49	29 54	684	11·3	7·27	55·2	4·74	...	21·5
5,100	75·0	23 44	0 51	31 0	682	10·8	7·42	56 0	5·00	...	22·1
5,200	80·0	24 30	0 53	32 6	680	10·4	7·56	56·8	5·28	...	22·7
5,300	85·0	25 18	0 55	33 16	679	10·0	7·71	57·6	5·56	...	23·4
5,400	90·5	26 8	0 58	34 30	678	10·0	7·85	58 4	5·84	...	24·1
5,500	96·5	26 58	1 0	35 48	677	9·6	8·00	59·2	6·12	...	24·8
5,600	103·0	27 50	1 3	37 12	677	9·6	8·14	59·9	6·40	...	25·5
5,700	109·5	28 42	1 6	38 42	678	9·2	8·29	60·6	6·69	...	26·2
5,800	116·0	29 36	1 9	40 12	679	8·3	8·43	61·3	6·98	...	26·9
5,900	122·5	30 36	1 11	41 57	680	8·3	1·58	62·0	7·27	...	27·7

Charge, 9¼ lb. R.L.G.[2] Muzzle velocity, 875 f.s.

Range.	Drift, right.	Elevation.	Deflection, left.	Angle of descent.	Remaining velocity.	Five minutes' elevation increases or decreases the range by	Five minutes will alter point of impact vertically or laterally, at each range	50 per cent. of rounds should fall within			Time of Flight.
								Length.	Breadth.	Height.	
yards.	yards.	° ′	° ′	° ′	yards.	yards.	yards.	yards.	yards.	yards.	secs.
300	...	0 48	...	...	857	20·8	0·43	...	...	...	...
400	...	1 12	...	...	851	20·0	0·58	...	...	...	...
500	0·4	1 37	0 3	2 3	845	19·2	0·72	6·2	0·20	0·23	1·6
600	0·6	2 3	0 3	2 36	839	19·5	0·87	7·5	0·24	0·37	1·9
700	0·8	2 31	0 4	3 3	833	18·5	1·01	8·7	0·28	0·51	2·3
800	1·1	2 57	0 5	3 30	828	18·5	1·16	9·9	0·32	0·65	2·6
900	1·5	3 24	0 6	3 57	823	18·5	1·31	11·1	0 36	0·80	3·0
1,000	1·9	3 51	0 7	4 24	818	18·5	1·45	12·3	0·40	0·95	3·4
1,100	2·3	4 18	0 7	4 51	812	18·5	1·60	13 5	0·45	1·19	3·8
1,200	2·9	4 45	0 8	5 18	807	18·5	1·74	14·7	0·50	1·44	4·2
1,300	3·5	5 12	0 9	5 48	802	18·5	1·89	15·9	0·55	1·69	4·6
1,400	4·1	5 39	0 10	5 18	797	18·5	2·03	17·0	0·60	1·94	5·0
1,500	4·8	6 6	0 11	6 48	792	18·5	2·18	18·1	0·65	2·19	5·4
1,600	5·6	6 33	0 12	7 18	787	18·5	2·32	19·2	0·70	2·52	5·8
1,700	6·5	7 0	0 13	7 48	782	17·8	2·47	20·3	0·75	2·86	6·2
1,800	7·5	7 28	0 14	8 18	777	17·8	2·61	21·4	0·80	3·20	6·6
1,900	8·5	7 56	0 15	8 48	772	17·8	2·76	22·5	0·86	3·54	7·0
2,000	9·5	8 24	0 16	9 18	767	17·8	2·91	23·6	0·92	3·88	7·4
2,100	10·5	8 52	0 17	9 51	762	17·8	3·05	24·7	0·98	4·36	7·8
2,200	11·5	9 20	0 18	10 24	757	17·8	3·20	25·8	1·04	4·84	8·2
2,300	12·5	9 48	0 19	11 0	752	17·8	3·34	26·9	1·10	5·33	8·6
2,400	14·0	10 16	0 20	11 36	747	17·8	3·49	28 0	1·17	5·82	9·1
2,500	15·5	10 44	0 21	12 12	742	16·6	3·63	29·0	1·25	6·31	9·6
2 600	17·0	11 14	0 22	12 48	737	16·6	3 78	30 0	1·33	6·91	10·1
2,700	18·5	11 44	0 23	13 24	732	16·6	3·92	31·0	1·41	7·52	10·6
2 800	20·0	12 14	0 24	14 0	727	15·6	4·07	32·0	1·50	7·83	11·1
2,900	21·5	12 46	0 25	14 36	723	15·6	4·21	33·0	1·59	8·34	11·6
3,000	23·0	13 18	0 26	15 15	719	15·6	4·36	34·0	1·69	9 35	12·1
3,100	24·5	13 50	0 27	15 54	715	14·7	4 51	35·0	1·79	10·13	12·6
3,200	26·5	14 24	0 28	16 36	711	14·7	4·65	36·0	1·90	10·91	13·1
3,300	28·5	14 58	0 30	17 18	707	14·7	4·80	36·9	2·01	11·69	13·6
3,400	30·5	15 32	0 31	18 0	703	14·7	4·94	37·8	2·12	12·47	14·1
3,500	32·5	16 6	0 32	18 42	698	13·9	5·09	38·7	2·24	13·25	14·6
3,600	34·5	16 42	0 33	19 26	695	13·9	5·23	39·6	2·39	14·14	15·1
3,700	36·7	17 18	0 34	20 12	691	13·9	5·38	40·5	2·54	15·03	15·6
3,800	39·0	17 54	0 35	21 0	687	13·9	5·52	41·4	2·69	15·92	16·1
3,900	41·5	18 30	0 37	21 48	683	13·1	5·67	42·3	2·84	16·81	16·7
4,000	44·0	19 8	0 38	22 36	680	13·1	5·81	43·2	3·00	17·70	17·3
4,100	47·0	19 46	0 39	23 30	677	13·1	5·96	44·1	3·16	19·04	17·9
4,200	50·0	20 24	0 41	24 24	674	13·1	6·11	45·0	3·32	20·38	18·5
4,300	53·0	21 2	0 42	25 18	671	12·5	6·25	45·8	3 49	...	19·1
4,400	56·5	21 42	0 44	26 12	668	12 5	6·50	46·6	3·66	...	19·7
4,500	60·0	22 22	0 46	27 6	665	12·5	6·54	47·4	3·84	...	20·3
4,600	60·4	23 2	0 48	28 0	662	12·5	6·69	48·2	4·02	...	21·9
4,700	68·0	23 42	0 50	29 0	659	11·9	6·84	49 0	4·21	...	21·5
4,800	72·5	24 24	0 52	30 0	656	11·9	6·98	49·8	4·41	...	22·2
4,900	77·0	25 6	0 54	31 0	653	11·9	7·13	50·6	4·63	...	22·9
5,000	81·5	25 48	0 56	32 6	650	11·3	7·27	51·4	4·87	...	23·6
5,100	86·0	26 32	0 58	33 12	648	11·3	7·42	52·1	5·15	...	24·3
5,200	91·0	27 16	1 0	24 34	647	10·8	7·56	52·8	5·43	...	25·0
5,300	96·0	28 2	1 2	35 36	646	10·8	7·71	53·5	5·71	...	25·8
5,400	101·0	28 48	1 4	36 48	645	10·4	7·85	54 2	5·99	...	26·6
5,500	106·0	29 36	1 6	38 0	644	10·4	8·00	54·9	6·27	...	27·4
5,600	111·0	30 24	1 8	39 24	643	10·4	8·14	55·6	6·55	...	28·2

Charge, 8¼ lb. R.L.G.[2] Muzzle velocity, 825 f.s.

Range.	Drift, right.	Elevation.	Deflection, left.	Angle of descent.	Remaining velocity.	Five minutes' elevation increases or decreases the range by	Five minutes will alter point of impact, vertically or laterally, at each range	50 per cent. of rounds should fall within			Time of Flight.
								Length.	Breadth.	Height.	
yards.	yards.	° ′	° ′	° ′	f.s.	yards.	yards.	yards.	yards.	yards.	secs.
300	...	0 54	...	...	808	16·6	0·43	...	...	...	...
400	...	1 24	...	...	803	16·6	0·58	...	...	...	...
500	0·5	1 24	0 3	2 30	798	16·6	0·72	5·9	0·22	0·26	1·7
600	0·8	2 24	0 5	3 0	793	16·6	0·87	7·1	0·27	0·41	2·0
700	1·2	2 54	0 6	3 30	788	16·6	1·01	8·3	0·32	0·56	2·3
800	1·6	3 24	0 7	4 0	783	16·6	1·16	9·4	0·37	0·71	2·6
900	2·0	3 54	0 8	4 30	778	16·6	1·31	10·5	0·42	0·87	3·0
1,000	2·5	4 24	0 9	5 3	773	16·6	1·45	11·6	0·47	1·03	3·4
1,100	3·0	4 54	0 9	5 36	768	16·6	1·60	12·7	0·52	1·30	3·8
1,200	3·6	5 24	0 10	6 9	763	16·6	1·74	13·8	0·57	1·57	4·2
1,300	4·3	5 54	0 11	6 42	758	16·6	1·89	14·9	0·62	1·84	4·6
1,400	5·1	6 25	0 13	7 12	753	16·6	2·03	16·0	0·67	2·11	5·0
1,500	6·0	6 56	0 14	7 48	749	15·6	2·18	17·1	0·72	2·38	5·4
1,600	7·0	7 28	0 15	8 24	744	15·6	2·32	18·2	0·78	2·69	5·8
1,700	8·0	8 0	0 16	9 0	739	15·4	2·47	19·3	0·84	3·00	6·2
1,800	9·0	8 33	0 17	9 36	734	15·4	2·61	20·4	0·90	3·31	6·7
1,900	10·0	9 6	0 18	10 12	729	15·4	2·76	21·4	0·96	3·62	7·2
2,000	11·2	9 39	0 19	10 48	725	15·4	2·91	22·4	1·02	3·93	7·7
2,100	12·5	10 12	0 20	11 30	720	14·7	3·05	23·4	1·08	4·56	8·2
2,200	13·8	10 46	0 22	12 12	716	14·7	3·20	24·4	1·15	5·19	8·7
2,300	15·2	11 20	0 23	12 44	712	14·7	3·34	25·4	1·22	5·82	9·2
2,400	16·7	11 54	0 24	13 36	708	13·9	3·49	26·4	1·30	6·46	9·7
2,500	18·3	12 30	0 25	14 18	704	13·9	3·63	27·4	1·38	7·10	10·2
2,600	20·0	13 6	0 26	15 0	700	13·1	3·78	28·4	1·47	7·80	10·7
2,700	21·7	13 44	0 28	15 45	696	12·5	3·92	29·3	1·56	8·50	11·2
2,800	23·5	14 24	0 29	16 30	692	11·9	4·07	30·2	1·66	9·20	11·7
2,900	25·5	15 6	0 30	17 20	688	11·9	4·21	31·1	1·76	9·90	12·2
3,000	27·5	15 48	0 31	18 10	684	11·3	4·36	32·0	1·87	10·60	12·8
3,100	29·5	16 32	0 33	19 0	680	10·8	4·51	32·9	1·98	11·54	13·4
3,200	31·5	17 18	0 34	19 54	676	10·8	4·65	33·8	2·10	12·48	14·0
3,300	33·5	18 4	0 35	20 48	672	10·8	4·80	34·7	2·22	13·42	14·6
3,400	36·0	18 50	0 36	21 42	668	10·4	4·94	35·5	2·35	14·36	15·2
3,500	38·5	19 38	0 38	22 36	664	10·4	5·09	36·3	2·50	15·30	15·8
3,600	41·0	20 26	0 39	23 36	661	10·0	5·23	37·1	2·66	16·52	16·4
3,700	43·7	21 16	0 41	24 36	658	9·6	5·38	37·9	2·82	17·74	17·0
3,800	46·5	22 8	0 42	25 40	655	9·6	5·52	38·7	2·98	18·96	17·6
3,900	49·5	23 0	0 44	26 46	652	9·2	5·67	39·5	3·14	20·18	18·2
4,000	52·5	23 54	0 45	27 56	649	9·2	5·81	40·3	3·30	...	18·9
4,100	56·0	24 48	0 47	29 12	647	8·9	5·96	41·1	3·47	...	19·6
4,200	59·5	29 44	0 49	30 36	645	8·6	6·11	41·9	3·65	...	20·3
4,300	63·0	26 42	0 50	32 0	644	8·3	6·25	42·7	3·83	...	21·0
4,400	66·5	27 42	0 52	33 42	643	8·3	6·40	43·5	4·02	...	21·7
4,500	70·5	28 42	0 54	35 24	642	8·3	6·54	44·3	4·21	...	22·4
4,600	74·5	29 42	0 56	37 9	641	8·3	6·69	45·1	4·41	...	23·2

Charge, 7½ lb. R.L.G.[2] Muzzle velocity, 770 f.s.

Range.	Drift, range.	Elevation.	Deflection, left.	Angle of descent.	Remaining velocity.	Five minutes' elevation increases or decreases the range by	Five minutes will alter point of impact vertically or laterally at each range	50 per cent. of rounds should fall within			Time of flight.
								Length.	Breadth.	Height.	
yards.	yards.	° ′	° ′	° ′	f.s.	yards.	yards.	yards.	yards.	yards.	secs.
300	...	1 0	...	...	755	13·9	0·43	...	...	...	...
400	...	1 36	...	...	750	13·9	0·58	...	...	...	...
500	0·7	2 12	0 5	2 58	746	13·9	0·72	5·6	0·24	0·28	1·3
600	1·2	2 48	0 7	3 32	741	13·9	0·87	6·7	0·29	0·45	2·1
700	1·7	3 24	0 8	4 6	736	13·9	1·01	7·8	0·34	0·62	2·5
800	2·2	4 0	0 9	4 42	731	13·9	1·16	8·9	0·39	0·79	2·9
900	2·7	4 36	0 10	5 18	727	13·9	1·31	10·0	0·44	0·96	3·3
1,000	3·3	5 12	0 11	5 54	723	13·9	1·45	11·1	0·49	1·14	3·7
1,100	4·0	5 48	0 13	6 30	718	13·9	1·60	12·2	0·55	1·39	4·1
1,200	4·8	6 24	0 14	7 6	713	13·9	1·74	13·2	0·61	1·64	4·5
1,300	5·7	7 0	0 15	7 45	708	13·9	1·89	14·2	0·67	1·89	4·9
1,400	6·7	7 36	0 17	8 24	704	13·9	2·03	15·2	0·73	2·14	5·3
1,500	7·7	8 12	0 18	9 3	700	13·9	2·18	16·2	0·79	2·40	5·7
1,600	8·8	8 48	0 19	9 42	695	13·9	2·32	17·2	0·85	2·86	6·2
1,700	10·0	9 24	0 20	10 24	690	13·9	2·47	18·2	0·91	3·32	6·7
1,800	11·5	10 0	0 22	11 6	686	13·9	2·61	19·2	0·98	3·78	7·2
1,900	13·0	10 36	0 24	11 48	682	13·9	2·76	20·2	1·05	4·25	7·7
2,000	14·5	11 12	0 25	12 30	678	13·1	2·91	21·2	1·12	4·72	8·2
2,100	16·0	11 50	0 26	13 15	673	13·1	3·05	22·2	1·19	5·30	8·7
2,200	17·5	12 28	0 27	14 0	669	12·5	3·20	23·1	1·26	5·88	9·2
2,300	19·2	13 8	0 29	14 48	665	12·5	3·34	24·0	1·34	6·46	9·7
2,400	21·0	13 48	0 30	15 36	661	12·5	3·49	24·0	1·42	7·01	10·3
2,500	23·0	14 18	0 32	16 24	657	11·9	3·63	24·9	1·51	7·63	10·9
2,600	25·0	15 0	0 33	17 12	653	11·3	3·78	25·8	1·61	8·38	11·5
2,700	27·0	15 44	0 34	18 3	649	10·8	3·92	26·7	1·71	9·13	12·1
2,800	29·0	16 30	0 36	18 54	645	10·8	4·07	27·6	1·82	9·88	12·7
2,900	31·0	17 16	0 37	19 48	641	10·8	4·21	28·4	1·93	10·64	13·3
3,000	33·2	18 2	0 38	20 42	637	10·4	4·36	29·2	2·04	11·40	13·9
3,100	35·5	18 50	0 39	21 36	633	9·6	4·51	30·0	2·16	12·40	14·5
3,200	38·0	19 42	0 41	22 36	629	9·2	4·65	31·6	2·29	13·40	15·2
3,300	40·5	20 36	0 42	23 36	626	9·2	4·80	32·4	2·42	14·40	15·9
3,400	43·0	21 30	0 44	24 36	623	9·2	4·94	33·2	2·55	15·40	16·6
3,500	45·5	22 24	0 45	25 36	620	9·2	5·09	34·0	2·70	16·40	17·3
3,600	48·5	23 18	0 46	26 42	617	8·9	5·23	34·8	2·86	17·84	18·0
3,700	51·5	24 14	0 48	27 54	615	8·6	5·38	35·6	3·04	19·28	18·7
3,800	54·5	25 12	0 49	29 6	613	8·3	5·52	36·4	3·22	20·72	19·4
3,900	58·0	26 12	0 51	30 18	611	8·3	5·67	37·2	3·41	...	20·2
4,000	61·5	27 12	0 53	31 42	609	8·0	5·81	38·0	3·60	...	21·0
4,100	65·5	28 14	0 55	33 12	607	7·8	5·96	38·8	3·80	...	21·8
4,200	69·5	29 18	0 57	34 58	605	7·8	6·11	39·6	4·00	...	22·6
4,300	71·0	30 24	1 0	36 46	603	7·8	6·25	40·4	4·21	...	23·5

Charge, 7 lb. R.L.G.[2] Muzzle velocity, 715 f.s.

Range.	Drift, right.	Elevation.	Deflection, left.	Angle of descent.	Remaining velocity.	Five minutes' elevation increases or decreases the range by	Five minutes will alter point of impact, vertically or laterally, at each range	50 per cent. of rounds should fall within			Time of flight.
								Length.	Breadth.	Height.	
yards.	yards.	° ′	° ′	° ′	f.s.	yards	yards.	yards.	yards.	yards.	secs.
300	...	1 20	...	...	700	13·9	0·43	...	..	...	...
400	...	1 56	...	...	695	13·9	0·58	...	...	...	...
500	0·8	2 32	0 6	3 0	690	13·9	0·72	5·4	0·27	0·20	1·8
600	1·2	3 8	0 7	3 36	686	13·1	0·87	6·4	0·33	0·46	2·2
700	1·7	3 46	0 8	4 12	682	13·1	1·01	7·4	0·39	0·63	2 6
800	2·3	4 24	0 10	4 54	678	13·1	1·16	8·4	0·45	0·80	3·0
900	3·0	5 2	0 11	5 36	674	13·1	1·31	9·4	0·51	0·98	3·4
1,000	3·8	5 40	0 13	6 18	670	13·1	1·45	10·4	0·57	1·16	3·8
1,100	4·7	6 18	0 15	7 0	666	13·1	1·60	11·4	0·63	1·46	4·2
1,200	5·7	6 56	0 16	7 42	662	13·1	1·74	12·4	0·69	1·77	4·6
1,300	6·8	7 34	0 18	8 24	658	13·1	1·89	13·4	0·76	2·08	5·1
1,400	8·0	8 12	0 19	9 9	654	12·5	2·03	14·4	0·82	2·39	5·6
1,500	9·2	8 52	0 21	9 54	650	12·5	2·18	15·4	0·88	2·70	6·1
1,600	10·5	9 32	0 22	10 42	646	12·5	2·32	16·4	0·94	3·16	6·6
1,700	11·9	10 12	0 24	11 30	642	12·5	2·47	17·3	1·01	3·62	7·1
1,800	23·3	10 52	0 25	12 18	638	12·5	2·61	18·2	1 08	4·08	7·6
1,900	14·8	11 32	0 27	13 6	634	12·5	2·76	19·1	1·15	4·54	8·1
2,000	16·4	12 12	0 28	14 0	631	12·5	2·91	20·0	1·22	5·00	8·6
2,100	18·1	12 52	0 30	14 54	628	12·5	3·05	20·9	1·30	5·66	9·1
2,200	19·8	13 32	0 31	15 48	625	12·5	3·20	21·8	1·38	6·32	9·6
2,300	21·6	14 12	0 33	16 42	622	11·3	3·34	22·7	1·46	6·98	10·2
2,400	23·5	14 56	0 34	17 42	619	10·3	3·49	23·6	1·54	7·65	10·8
2,500	25·5	15 42	0 35	18 42	616	10·4	3·63	24·5	1·63	8·32	11·4
2,600	27 5	16 30	0 36	19 42	613	10·4	3·78	25·4	1·72	9·08	12·0
2,700	29·7	17 18	0 37	20 42	610	10·4	3·92	26·3	1·81	9·84	12·6
2,800	32·0	18 6	0 39	21 48	607	9·2	4·07	27·2	1·91	10·60	13·3
2,900	34·3	19 0	0 40	22 54	604	9·2	4·21	28·0	2·02	11·36	14·0
3,000	37·0	19 54	0 42	24 6	601	8·9	4·36	28·8	2·13	12·13	14·7
3,100	39·7	20 50	0 44	25 18	598	8·3	4·51	29·6	2·24	13·62	15·4
3,200	42·5	21 50	0 45	26 36	595	7·8	4·65	30·4	2·37	15·11	16·1
3,300	45·5	22 54	0 47	27 57	592	7·5	4·80	31·2	2·50	16·60	16·8
3,400	48·7	24 0	0 49	29 18	590	6·9	4·94	32·0	2·65	18·10	17·5
3,500	52 0	25 12	0 51	30 48	588	6·9	5·09	32·8	2·80	19·60	18·3
3,600	56·0	26 54	0 53	32 24	587	6·7	5·23	33·6	2·95	...	19·1
3,700	60·0	27 38	0 55	34 12	588	6·0	5·38	34·4	3·12	...	19·9
3 800	64·0	29 0	0 58	36 12	589	5·9	5·52	35·2	3·32	...	20·7
3,900	68·5	30 24	1 0	38 30	590	5·8	5·67	36·0	3·52	...	21·5

Charge, 6½ lb. R.L.G.[2] Muzzle velocity, 710 f.s.

Range.	Drift, right.	Elevation.	Deflection, left.	Angle of descent.	Remaining velocity.	Five minutes' elevation increases or decreases the range by	Five minutes will alter point of impact vertically or laterally at each range	50 per cent. of rounds should fall within			Time of flight.
								Length.	Breadth.	Height.	
yards.	yards.	° ′	° ′	° ′	f.s.	yards.	yards.	yards.	yards.	yards.	secs.
300	...	1 24			696	12·5	0·43	...	...	...	...
400	...	2 4	...	...	692	12·5	0·58	...	...	...	...
500	0·9	2 44	0 6	3 22	688	12·2	0·72	5·2	0·30	0·30	1·9
600	1·5	3 25	0 9	4 4	684	12·2	0·87	6·2	0·36	0·48	2·3
700	2·1	4 6	0 10	4 46	680	11·9	1·01	7·2	0·42	0·67	2·7
800	2·8	4 48	0 12	5 30	676	11·9	1·16	8·2	0·48	0·86	3·1
900	3·6	5 30	0 14	6 14	672	11·9	1·31	9·2	0·54	1·05	3·5
1,000	4·5	6 12	0 16	6 58	668	11·9	1·45	10·1	0·60	1·24	3·9
1,100	5·5	6 54	0 17	7 42	664	11·9	1·60	11·0	0·67	1·54	4·3
1,200	6·5	7 36	0 19	8 27	660	11·9	1·74	11·9	0·74	1·84	4·8
1,300	7·5	8 18	0 20	9 12	656	11·9	1·89	12·8	0·81	2·14	5·3
1,400	8·5	9 0	0 21	9 57	652	11·9	2·03	13·7	0·88	2·45	5·8
1,500	9·8	9 42	0 22	10 42	648	11·9	2·18	14·6	0·95	2·76	6·3
1,600	11·2	10 24	0 24	11 33	644	11·9	2·32	15·5	1·02	3·23	6·8
1,700	12·7	11 6	0 26	12 24	640	11·9	2·47	16·4	1·09	3·70	7·3
1,800	14·4	11 48	0 28	13 15	636	11·6	2 61	17·3	1·16	4·17	7·8
1,900	16·2	12 31	0 29	14 6	632	11·6	2·76	18·2	1·24	4·64	8·4
2,000	18·0	13 14	0 31	15 0	628	11·6	2·91	19·1	1·32	5·11	9·0
2,100	19·8	13 57	0 32	15 54	624	11·6	3·05	19·9	1·40	5·76	9·6
2,200	21·7	14 40	0 34	16 48	620	11·3	3·20	20·7	1·49	6·42	10·2
2,300	23·7	15 24	0 35	17 42	616	10·8	3·34	21·5	1·58	7·08	10·8
2,400	25·7	16 10	0 37	18 42	612	10·0	3·49	22·3	1·67	7·74	11·4
2,500	28·0	17 0	0 39	19 42	608	9·6	3·63	23·1	1·76	8·40	12·0
2,600	30 5	17 52	0 40	20 42	604	8·9	3·78	21·9	1·86	9·29	12·7
2,700	33·5	18 48	0 42	21 48	601	8·6	3·92	24·7	1·94	10·18	13·4
2,800	35·5	19 46	0 44	22 54	598	8·3	4·07	25·5	2·06	11·07	14·1
2,900	38·0	20 46	0 45	24 0	595	8·0	4·21	26·3	2·17	11·96	14·8
3,000	40·7	21 48	0 47	25 12	592	7·6	4·36	27·1	2·23	12·85	15·5
3,100	43·7	22 54	0 48	26 30	590	6·7	4·51	27·9	2·40	14·44	16·2
3,200	46·7	24 8	0 50	27 54	588	6·5	4·65	28·6	2 52	16·03	16·9
3,300	49·7	25 24	0 52	29 24	586	6·4	4·80	29·3	2·65	17·62	17·7
3,400	53·0	26 42	0 54	31 0	584	5·8	4·94	30·0	2·79	19·21	18 5
3,500	56·5	28 8	0 56	33 0	582	5·6	5·09	30·7	2·94	20·80	19·3
3,600	60·5	29 36	0 58	35 24	581	5·2	5·23	31·4	3·09	...	20·2

Charge, 5½ lb. R.L.G.[2] Muzzle velocity, 641 f.s.

300	...	1 48	...	...	629	10·8	0·43	...	...	...	...
400	...	2 34	...	...	625	10·8	0·58	...	...	...	...
500	1·3	3 20	0 9	3 49	621	10·8	0·72	4·7	0·36	0·31	2·2
600	2·1	4 6	0 12	4 36	617	10·4	0·87	5·6	0·43	0·50	2·7
700	2·9	4 54	0 14	5 30	613	10·0	1·01	6·5	0·50	0·70	3·1
800	3·7	5 44	0 16	6 24	609	9·6	1·16	7·4	0·57	0·90	3·7
900	4·7	6 36	0 18	7 18	605	9·6	1·31	8·2	0·64	1·10	4·2
1,000	5·7	7 28	0 20	8 12	601	9·6	1·45	9·0	0·71	1 30	4·7
1,100	7·0	8 20	0 22	9 6	597	9·6	1·60	9·8	0·79	1·65	5·2
1,200	8·5	9 12	0 24	10 6	593	9·2	1·74	10·6	0·87	2·00	5·7
1,300	10·0	10 6	0 26	11 6	589	9·2	1·89	11·4	0·95	2·35	6·2
1,400	11·5	11 0	0 28	12 6	585	9·2	2·03	12·2	1·03	2·70	6·7
1,500	13·2	11 54	0 30	13 12	582	9·2	2·18	13·0	1·11	3·06	7·3
1,600	15·0	12 48	0 32	14 18	579	9·2	2·32	13·8	1·19	3·61	7·9
1,700	17·0	13 42	0 34	15 24	576	9·2	2·47	14·6	1·27	4·16	8 5
1,800	19·0	14 36	0 36	16 36	573	9·2	2·61	15·4	1·35	4·71	9·1
1,900	21·0	15 30	0 38	17 48	570	9·2	2·76	16·2	1·43	5·27	9·7
2,000	23·2	16 24	0 40	19 0	567	9·2	2·91	17·0	1·52	5·83	10·3
2,100	25·5	17 18	0 42	20 18	564	9·2	3·05	17·8	1·61	6·68	10·9
2,200	28·0	18 12	0 44	21 36	561	9 2	3·20	18·5	1·70	7·53	11·5
2,300	30·5	19 6	0 46	23 0	558	8·3	3·34	19·2	1·79	8·38	12·2
2,400	33·0	20 6	0 47	24 24	556	7·6	3·49	19·9	1·88	9·24	12·9
2,500	35·7	21 12	0 49	25 54	551	5·9	3·63	20·6	1·96	10·10	13·6
2,600	38·4	22 36	0 51	27 30	555	5·9	3·78	21·3	2·06	11·70	14·3
2,700	41·2	24 0	0 53	29 18	556	5·2	3·92	22·0	2·15	13·30	15·0
2,800	41·2	25 36	0 54	31 18	557	5·2	4·07	22·7	2·24	14·90	15·7
2,900	47·2	27 12	0 56	33 36	559	4·6	4·21	23·4	2·34	16·50	16·4
3,000	50·2	29 0	0 58	36 42	561	4·6	4·36	24 1	2·44	18·10	17·1

Charge, 4½ lb. R.L.G.[2] Muzzle velocity, 556 f.s.

Range.	Drift, right.	Elevation.	Deflection, left.	Angle of descent.	Remaining velocity.	Five minutes' elevation increases or decreases the range by	Five minutes will alter point of impact vertically, or laterally, at each range	50 per cent. of rounds should fall within			Time of flight.
								Length.	Breadth.	Height.	
yards.	yards.	° ′	° ′	° ′	f.s.	yards.	yards.	yards.	yards.	yards.	secs.
300	...	2 36	...	...	544	9·2	0·43	...	...	...	...
400	...	3 30	...	...	540	9·2	0·58	...	...	...	...
500	1·9	4 24	0 13	4 36	537	8·9	0·72	4·2	0·41	0·34	2·6
600	2·7	5 20	0 15	5 42	534	8·6	0·87	5·0	0·50	0·56	3·2
700	3·6	6 10	0 18	6 48	531	8·0	1·01	5·8	0·58	0·76	3·8
800	4·7	7 20	0 20	7 54	528	7·8	1·16	6·5	0·66	0·98	4·4
900	6·0	8 24	0 23	9 0	525	7·5	1·31	7·2	0·75	1·20	5·0
1,000	7·5	9 30	0 26	10 12	522	7·3	1·45	7·9	0·83	1·42	5·6
1,100	9·3	10 38	0 29	11 30	519	7·1	1·60	8·6	0·92	1·82	6·2
1,200	11·2	11 48	0 32	12 48	516	6·9	1·74	9·3	1·00	2·22	6·8
1,300	13·4	13 0	0 35	14 6	513	6·7	1·89	10·0	1·08	2·63	7·4
1,400	15·8	14 14	0 39	15 30	510	6·5	2·03	10 7	1·17	3·04	8·1
1,500	18·3	15 30	0 42	16 54	507	6·4	2·18	11·4	1·26	3·45	8 8
1,600	21·1	16 48	0 45	18 24	504	6·0	2·32	12·1	1·35	4·16	9·5
1,700	24·2	18 10	0 49	19 54	501	5·9	2·47	12·8	1 44	4·89	10·2
1,800	27·4	19 34	0 52	21 30	498	5·8	2·61	13·5	1·53	5·56	11·0
1,900	30·8	21 0	0 56	23 12	495	5·5	2·76	14·2	1·62	6·27	11·8
2,000	34·5	22 30	0 59	25 0	493	5·4	2 91	14·9	1·71	6·98	12 6
2,100	38·4	24 2	1 3	26 48	491	5·3	3·06	15 6	1·80	8·11	13·4
2 200	42·4	25 36	1 6	28 42	489	5·2	3 20	16·3	1·89	9·34	14·3
2,300	46·6	27 12	1 10	30 48	487	4·8	3·34	16·9	1·98	10·37	15·2
2,400	51·4	28 56	1 14	32 12	486	4·7	3·49	17·5	2·07	11·50	16·2

Charge, 3½ lb. R.L.G.[2] Muzzle velocity, 473 f.s.

300	...	3 12	...	...	464	6·0	0·43	...	...	...	...
400	...	4 30	...	...	460	6·0	0·58	...	...	...	...
500	2·2	5 56	0 15	6 54	457	6·0	0·72	8·2	0·55	1·0	3·2
600	3·0	7 12	0 17	8 18	454	5·8	0·87	10·1	0·67	1·5	3·9
700	3·9	8 38	0 19	9 42	451	5·7	1·01	11·9	0·80	2·0	4·6
800	5·1	10 6	0 22	11 8	448	5·5	1·16	13·8	0·93	2·7	5·3
900	6·3	11 36	0 24	12 30	445	5·3	1·31	15·7	1·06	3·5	6·0
1,000	7·7	13 10	0 26	14 6	442	5·1	1·45	17·6	1·20	4·4	6·8
1,100	9·4	14 48	0 29	15 48	440	4·7	1·60	19·6	1·35	5·5	7·6
1,200	11·4	16 33	0 33	17 30	438	4·6	1·74	21·7	1·50	6·9	8 4
1,300	13·5	18 21	0 36	19 18	436	4·4	2·89	23·8	1·66	8·4	9·2
1,400	16·0	20 15	0 39	21 18	431	4·2	2·03	25·9	1·83	10·1	10·0
1,500	19·0	22 15	0 43	23 30	432	4·0	2·18	28·1	2·00	12·3	10·9
1,600	22·3	24 21	0 48	26 0	433	3·6	2·32	30·4	2·18	14·9	11·8
1,700	27·0	26 38	0 54	28 42	434	3·1	2·47	32·9	2·37	18 0	12·8
1,800	34·0	29 18	1 5	32 6	435	2·7	2·61	35·4	2·57	22·4	13·8
1,900	42·2	32 24	1 16	37 37	436	2·1	2·76	38·2	2·80	29·4	14·9

Approximate Range Table for Star Shell. Charge, 3½ lb.

Range.	Elevation.	Length of Fuze.
1,000 yards.	7° 0′	2·5
1,100 „	7° 53′	5·0
1,200 „	8° 49′	7·5
1,300 „	9° 49′	10·0
1,400 „	10° 54′	12·5
1,500 „	12° 3′	15·0
1,600 „	13° 18′	17.5
1,700 „	14° 38′	20·0
1,800 „	15° 3′	22·5
1,900 „	17° 33′	25·0
2,000 „	19° 6′	27 5
2,100 „	20° 42′	30·0

TABLE showing Gradients corresponding to Angles of Descent.

Angle of Descent.		Slope of Descent.	Angle of Descent.		Slope of Descent.
degs.	mins.		degs.	mins.	
1	9	1 in 50	27	10	1 in 1·95
1	55	1 „ 30	27	47	1 „ 1·90
2	13	1 „ 26	28	24	1 „ 1·85
2	18	1 „ 25	29	3	1 „ 1·80
2	23	1 „ 24	29	45	1 „ 1·75
2	52	1 „ 20	30	28	1 „ 1·70
3	1	1 „ 19	31	13	1 „ 1·65
3	11	1 „ 18	32	2	1 „ 1·60
3	23	1 „ 17	32	50	1 „ 1·55
3	35	1 „ 16	33	42	1 „ 1·50
3	49	1 „ 15	34	36	1 „ 1·45
4	5	1 „ 14	35	32	1 „ 1·40
4	24	1 „ 13	36	32	1 „ 1·35
4	46	1 „ 12	37	34	1 „ 1·30
5	13	1 „ 11	38	41	1 „ 1·25
5	43	1 „ 10	39	50	1 „ 1·20
6	19	1 „ 9	41	2	1 „ 1·15
7	11	1 „ 8	42	16	1 „ 1·10
8	8	1 „ 7	43	38	1 „ 1·05
9	28	1 „ 6	45	0	1 „ 1·0
10	18	1 „ 5·5	46	28	1 „ ·96
11	19	1 „ 5·0	48	1	1 „ ·90
11	46	1 „ 4·8	48	39	1 „ ·88
12	16	1 „ 4·6	49	18	1 „ ·86
12	48	1 „ 4·4	49	58	1 „ ·84
13	23	1 „ 4·2	50	39	1 „ ·82
14	2	1 „ 4·0	51	20	1 „ ·80
14	45	1 „ 3·8	52	3	1 „ ·78
15	32	1 „ 3·6	52	46	1 „ ·76
16	23	1 „ 3·4	53	30	1 „ ·74
17	22	1 „ 3·2	54	15	1 „ ·72
18	26	1 „ 3·0	55	0	1 „ ·70
19	2	1 „ 2·9	55	46	1 „ ·68
19	40	1 „ 2·8	56	34	1 „ ·66
20	20	1 „ 2·7	57	23	1 „ ·64
21	3	1 „ 2·6	58	13	1 „ ·62
21	48	1 „ 2·5	59	3	1 „ ·60
22	38	1 „ 2·4	59	53	1 „ ·58
23	31	1 „ 2·3	60	45	1 „ ·56
24	26	1 „ 2·2	61	38	1 „ ·64
25	28	1 „ 2·1	62	35	1 „ ·52
26	34	1 „ 2·0	63	26	1 „ ·50

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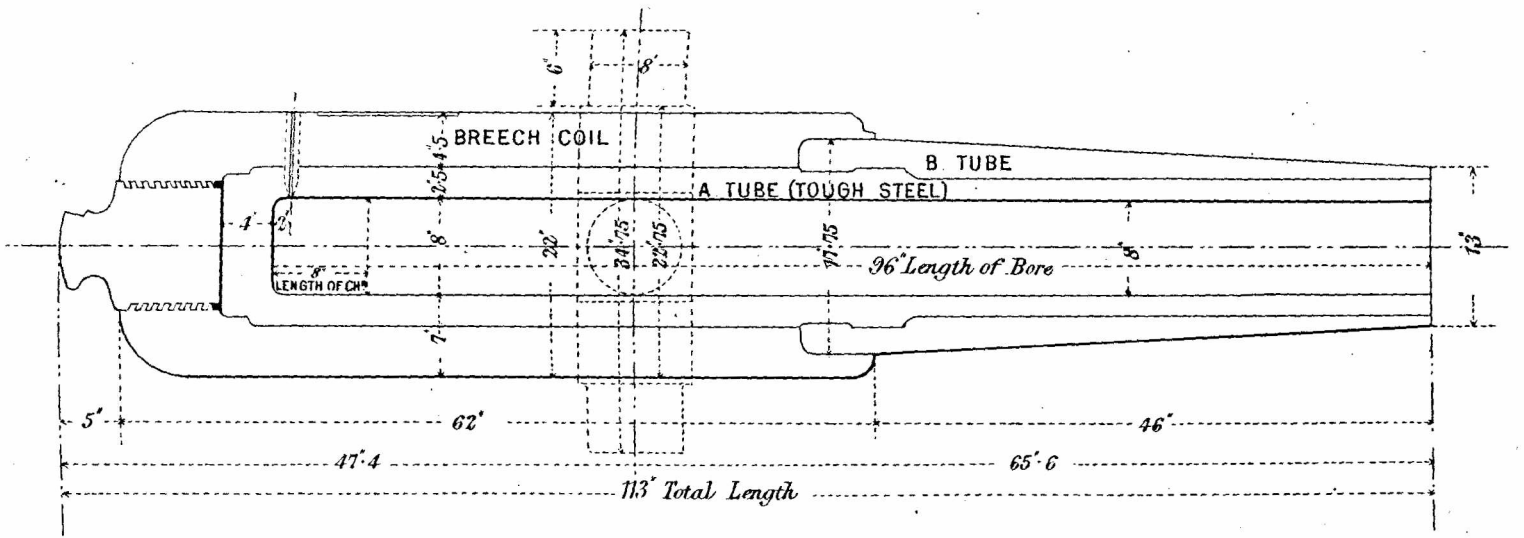
ORDNANCE, WROUGHT IRON, R.M.L. HOWITZER, 8 INCH 70 CWT, MARK I.

Scale 1/16.



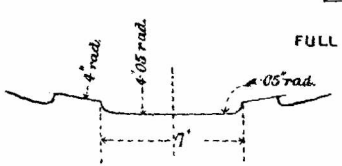
NUMBER OF GROOVES 24.

RIFLING. AN INCREASING TWIST FROM 1 TURN IN 90 CALS AT BREECH TO 1 TURN IN 35 CALS AT MUZZLE.

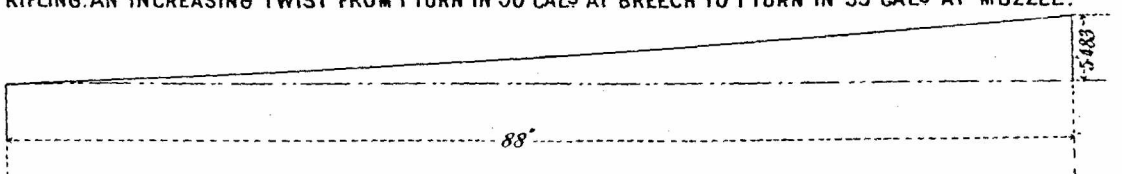
END OF GROOVES

.05"

FULL SIZE.



SECTION OF GROOVE
FULL SIZE.



DEVELOPMENT OF GROOVE.

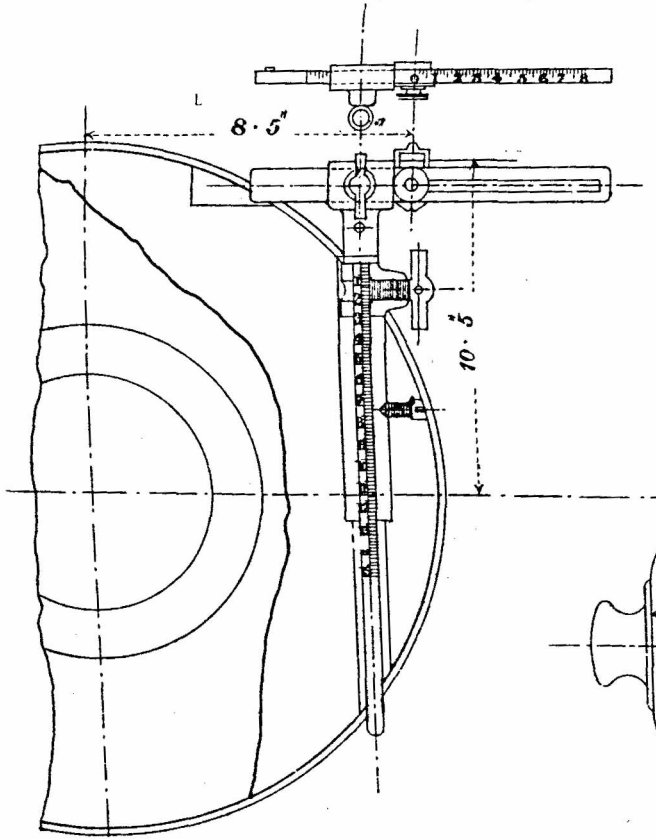
Plate I.

Wyman & Sons, Ltd., Lith, 6089.3.95.

ORDNANCE, WROUGHT, IRON, R. M. L. HOWITZER, 8 INCH 70 CWT MARK I.

SIGHTING.

Scale $\frac{1}{8}$



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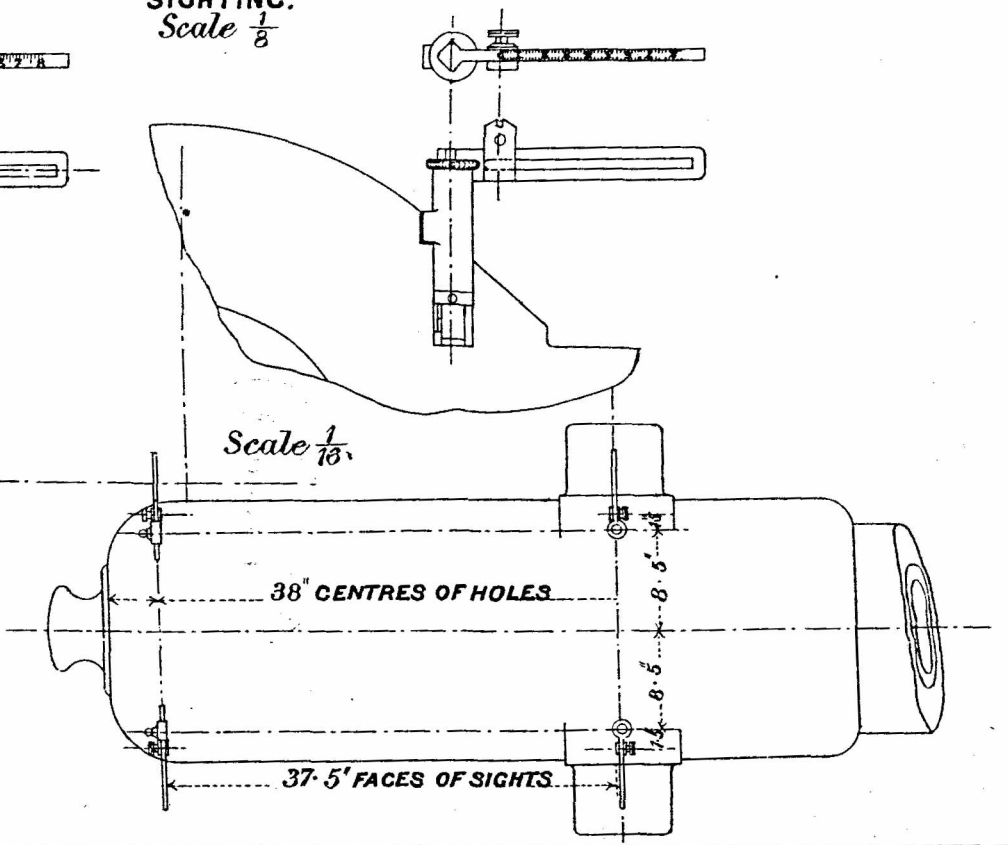
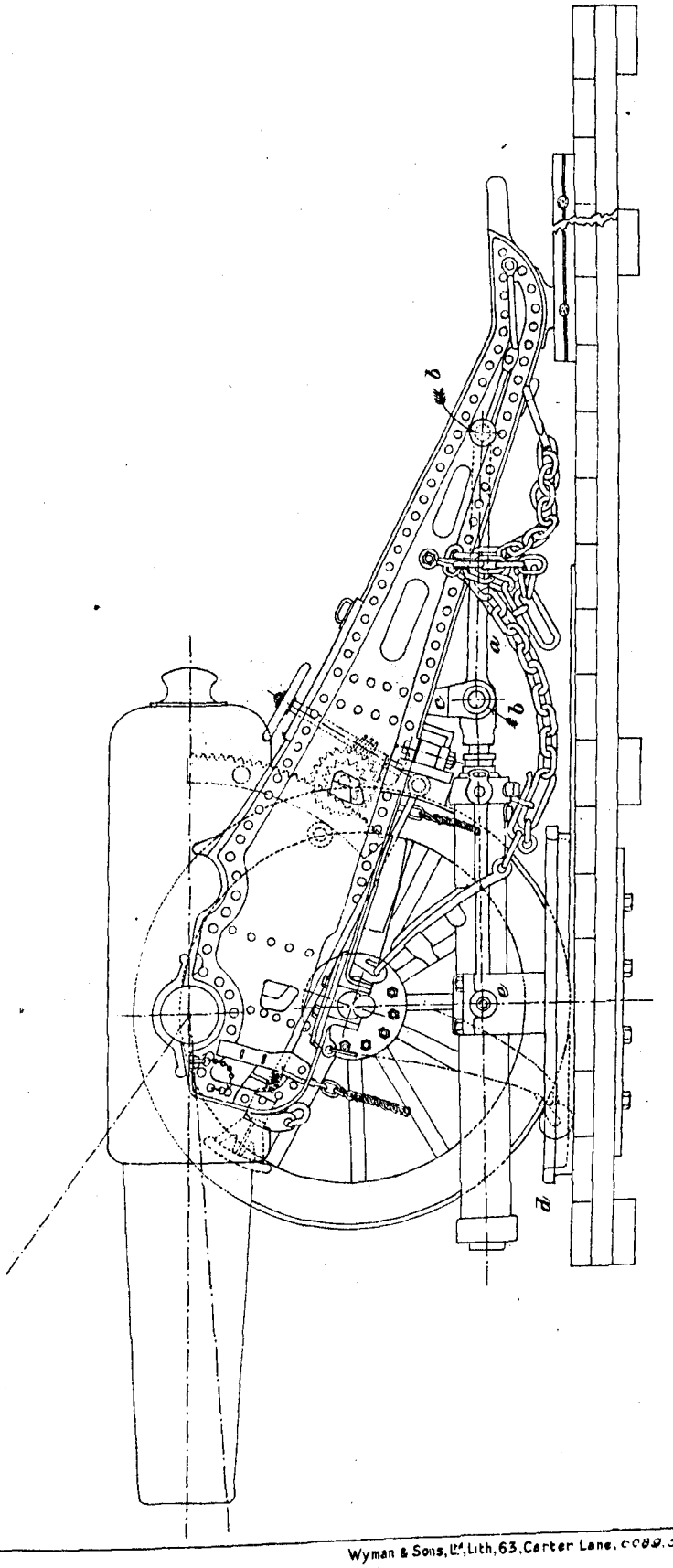


Wyman & Sons, Lt.d, Lith, 63, Carter Lane. 6089.

Plate II

CARRIAGE, SIEGE, R. M. L. 8-INCH 70-CWT. HOWITZER. MARK I.



Wyman & Sons, Lt., Lith, 63, Carter Lane. c080.5.94

CARRIAGE, SIEGE, R.M.L. 8-INCH, 70-CWT. HOWITZER, (CONVERTED, 8-INCH, 46 CWT.) MARK I.

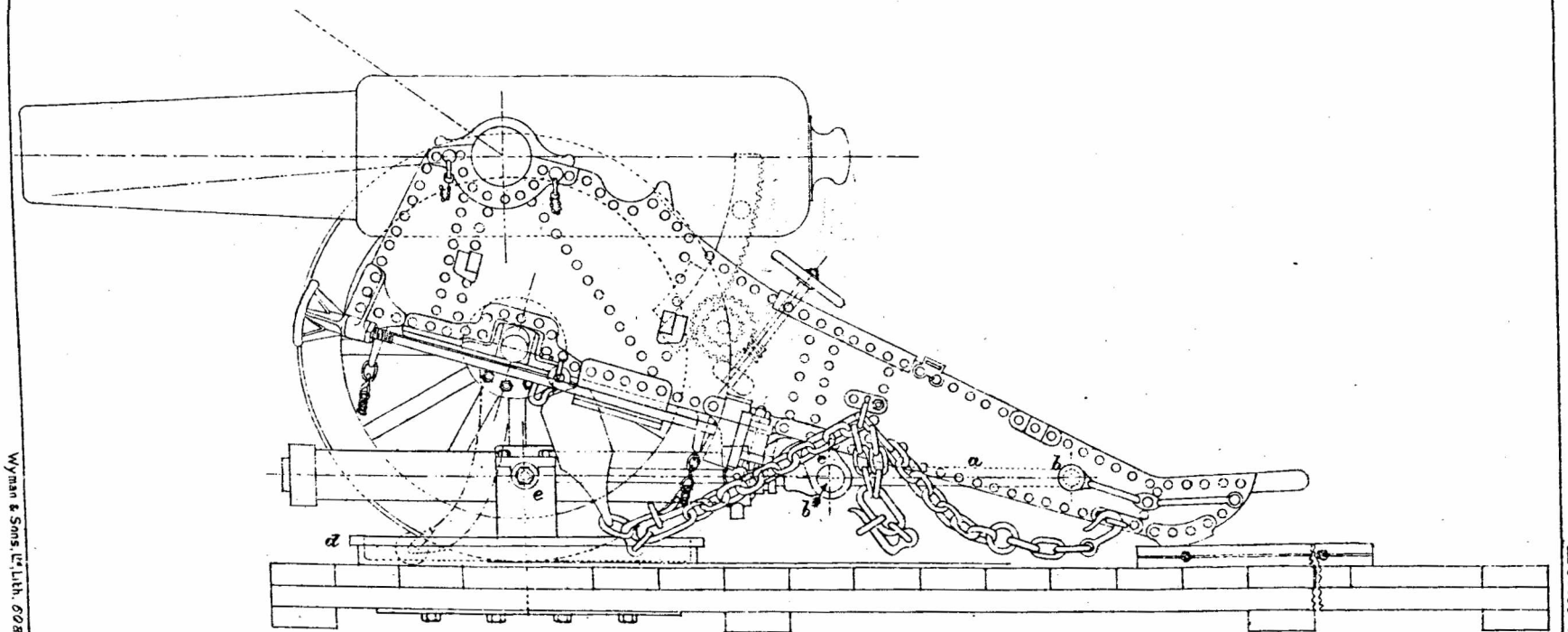


Plate IV.

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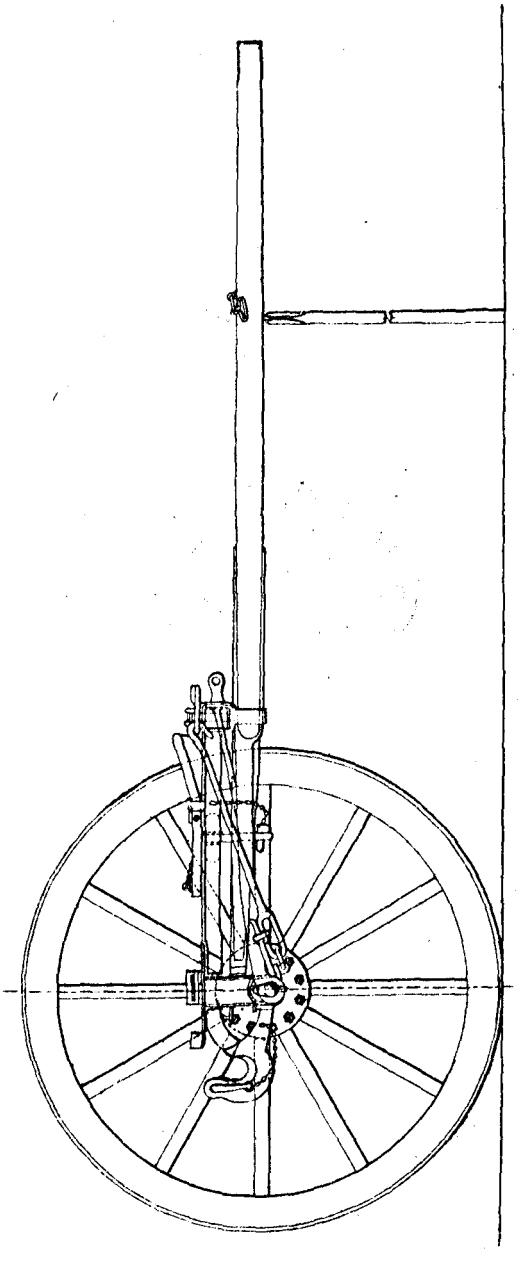
LIMBER, SIEGE, R.M.L. MARK I.

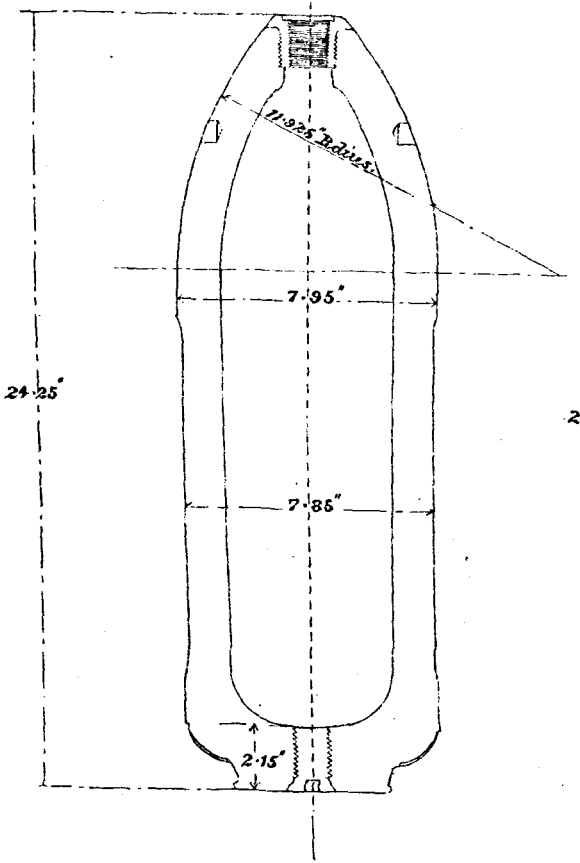


Wyman & Sons, Ltd, Lith, 63, Carter Lane.

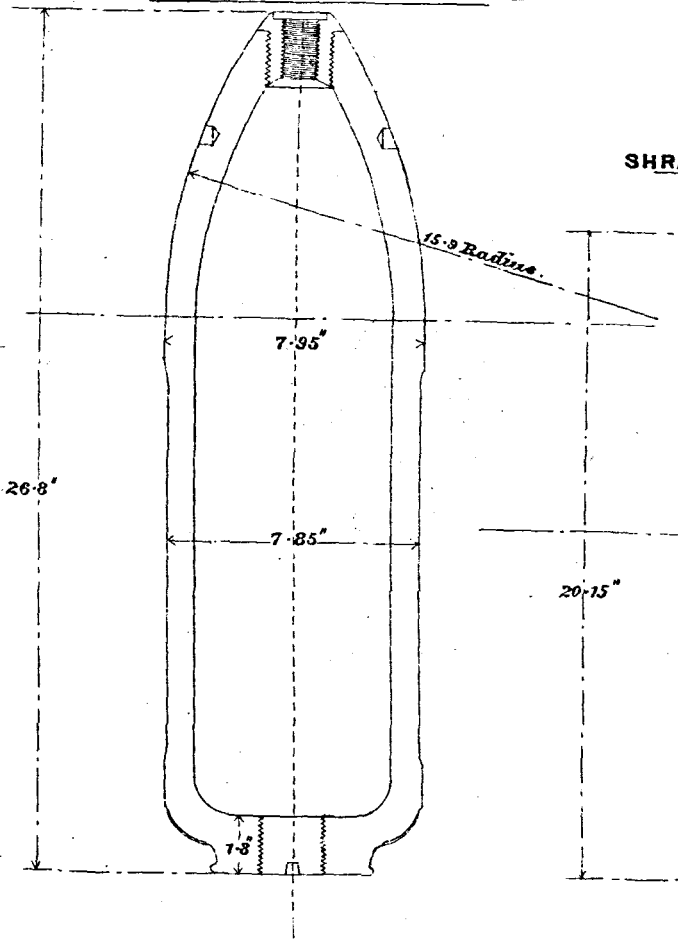
Scale ½.

PROJECTILES R.M.L. HOWITZER 8 INCH 70 CWT.

COMMON IRON MARK II.



COMMON CAST STEEL MARK III.



SHRAPNEL CAST STEEL MARK I.

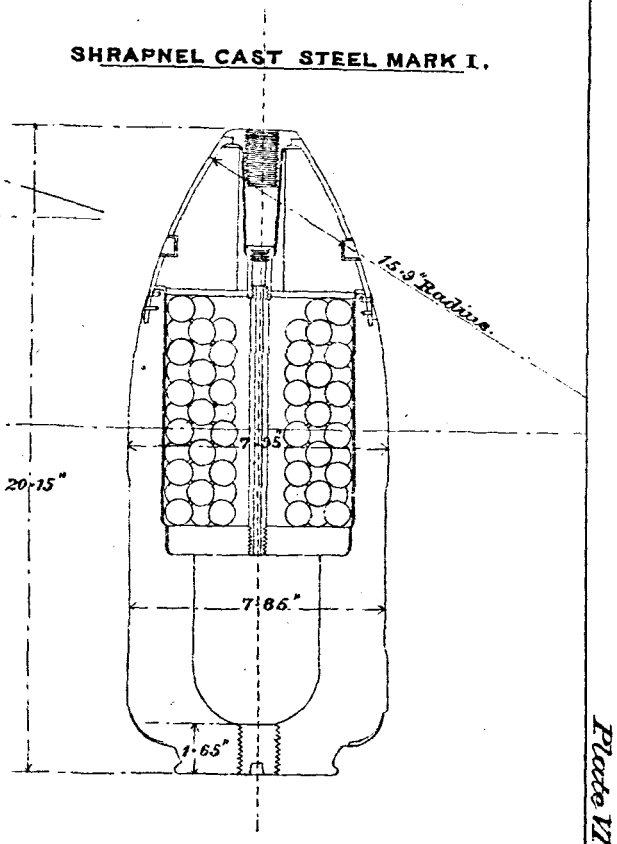


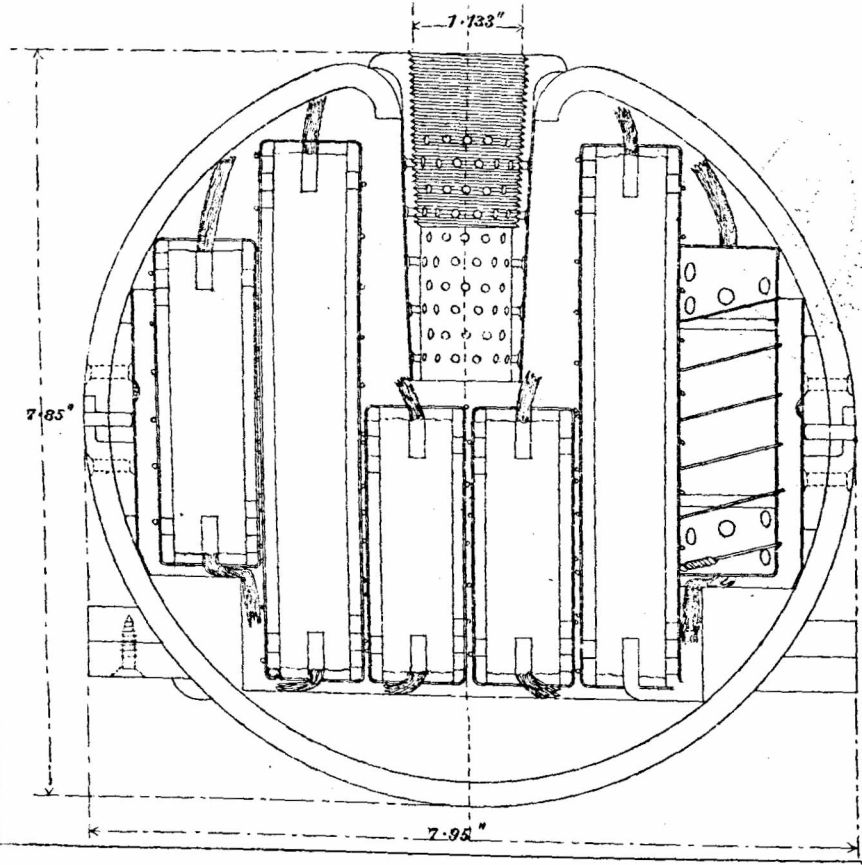
Plate VI

Wyman & Sons, Ltd. Lith. 6083 5.94.

PROJECTILES R.M.L HOWITZER 8 INCH 70 CWT.

Scale ½.

STAR SHELL MARK IV.



CASE SHOT. MARK III.

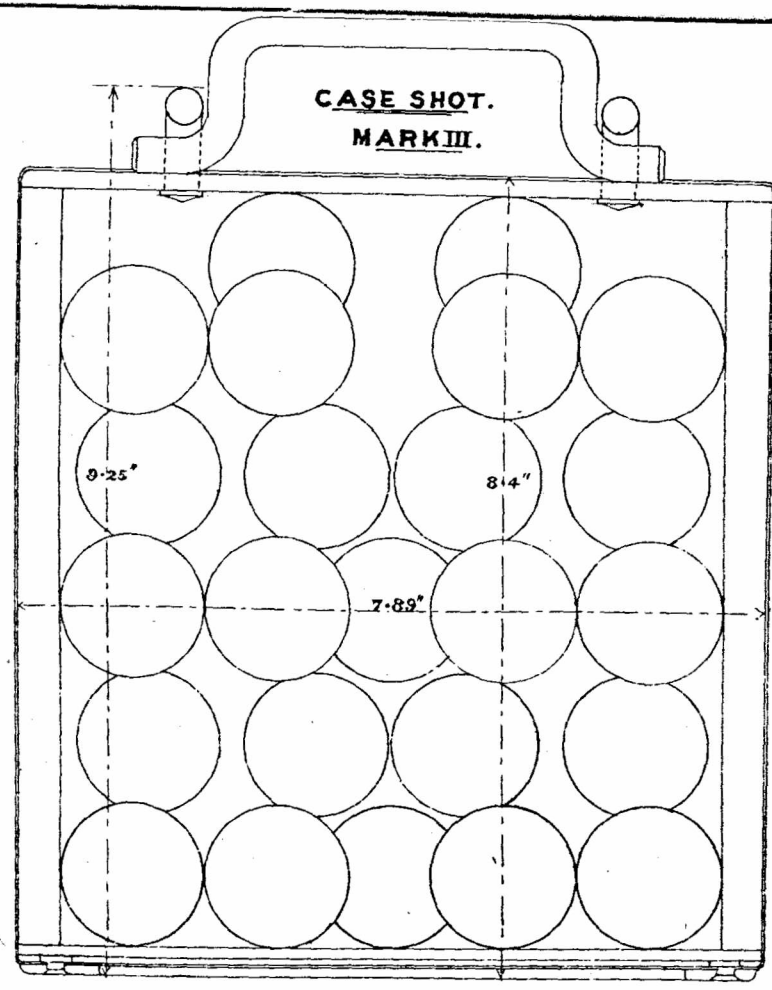


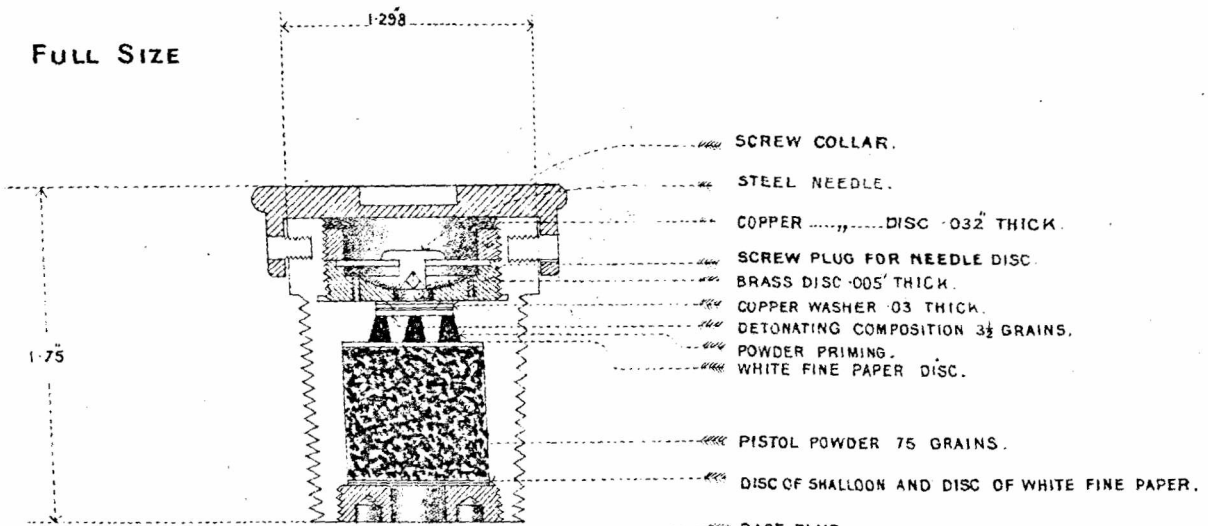
Plate. VII

Wyman & Sons, Ltd. Lith. 6003. 6.94.

FUZE, PERCUSSION, DIRECT ACTION, Nº 3. MARK II.

METAL 5 IN A TIN CYLINDER.

FULL SIZE



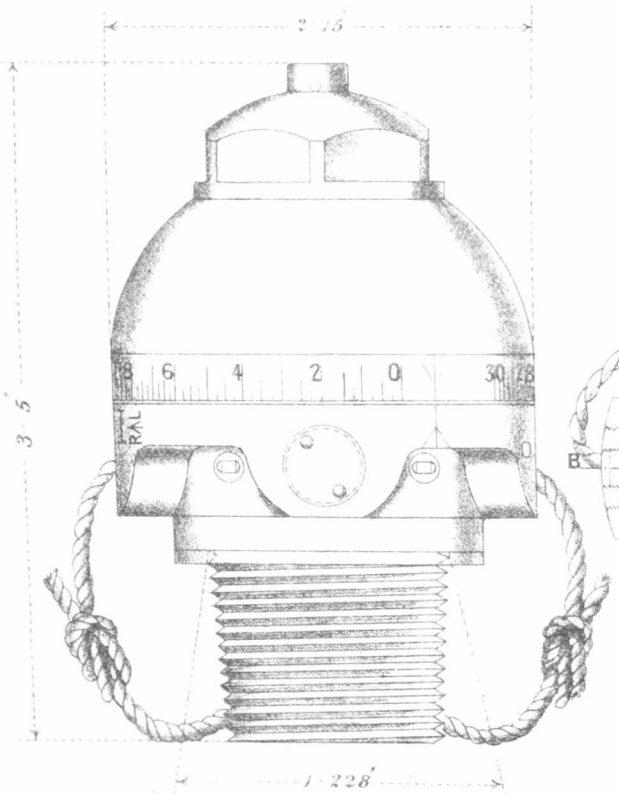
Wyman & Sons Limited, 63 Fetter Lane E.C.4.

Plate VIII.

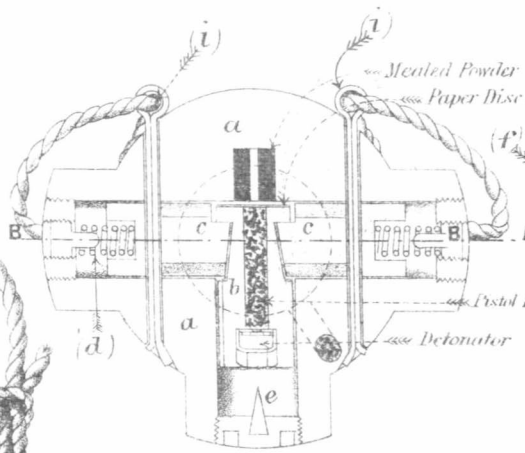
FUZE TIME, SENSITIVE MIDDLE N° 24, MARK I.

SCALE $\frac{1}{1}$.

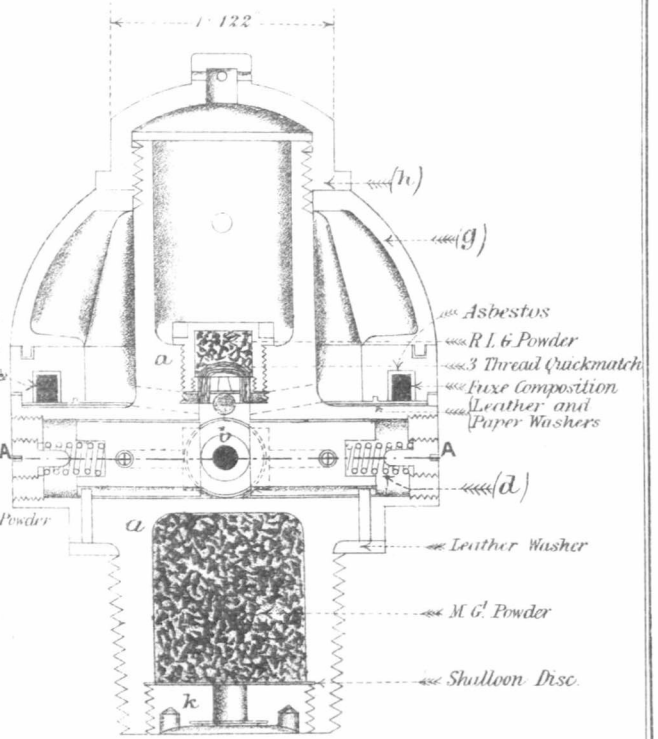
WEIGHT = 1 LB. 4 OZ.



ELEVATION SET AT "SAFETY."



SECTION AT A. A.



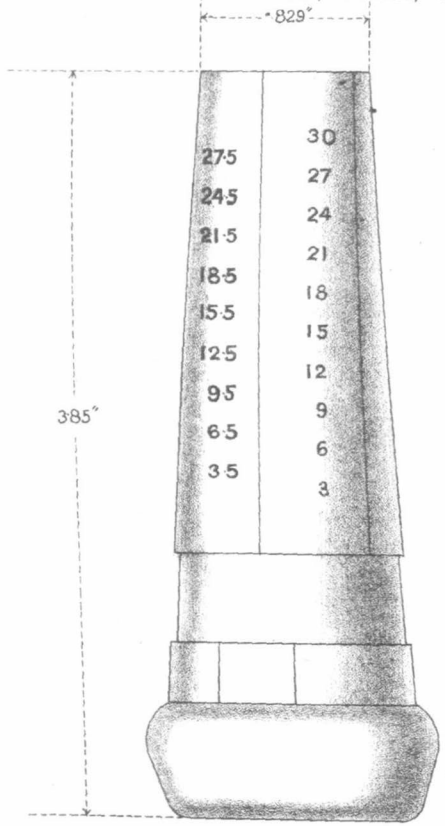
SECTION AT B B

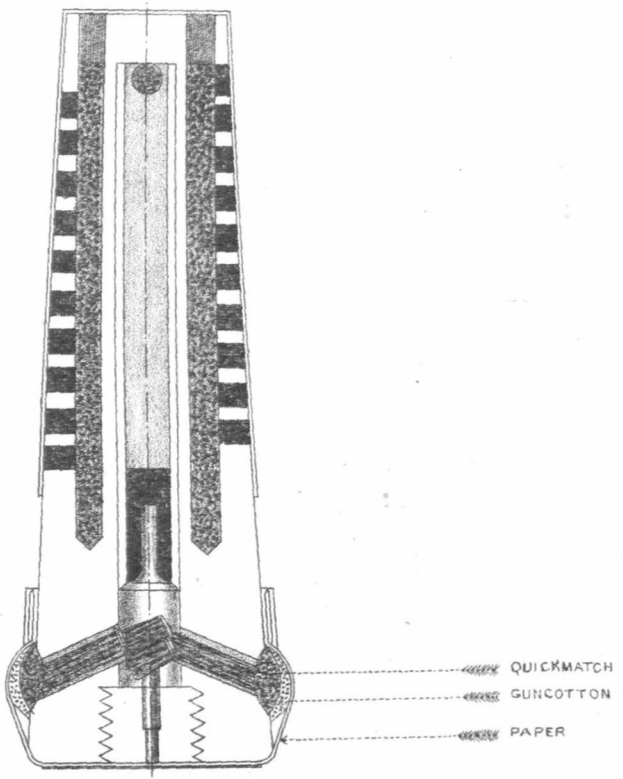
Plate IX.

Wyman & Sons, Ltd. Lith 8089. 3.95.

FUZE, TIME, 15 SECONDS M. L, SPECIAL, PRIMING, MARK I.

Full Size.





Wyman & Sons, Ltd. Lith

CARRIAGE AND LIMBER
PACKED FOR 6·6IN AND 8IN 70CWT HOWITZERS

LIMBER.

ON FOOTBOARD

1 pair of drag ropes, heavy *swingletree*
lifting jack, "Clerks"
spanner, hydraulic, No 1.
1st class drag washer B under.
maul, under *bill hook, under*

swingletree *shovel, water brush* } *under.*

LIMBER BOX

spade *swingletree* } *under.*

bulls eye lamp in box.
pickaxe under.

grease tin 3 lbs *water bucket* } *under*

can

can, spanner, handspike.

GUN CARRIAGE

can, hand-pincers, handspike

3 handspikes.

water brush
claw hammer.

arc elevating.
dragshoe & chain

tampeon with lanyard,
roller, shifting No 3 §
roller, scotch 8 in & 6·6 in.

§ *No 4. for 6·6 inch howr*

DETAILED CONTENTS OF LIMBER BOX.

8IN 70 CWT AND 6·6IN HOWITZER LIMBER BOX LID.

1 Sight, fore.
1 Sight, fore.
1 Clipper, portfire.
1 Clamp, tangent, sight "B"
1 Extracter, faxe.
1 Clamp, tangent sight "B"
1 Pricker, vent. ※
1 Sight, tangent.
1 Pincers, shrapnel, primer
1 Sight, tangent.
1 Spike, spring.

8IN 70 CWT AND 6·6IN HOWITZER LIMBER BOX.

1 Can, oil, lubricating.	*1 Wrench, pivot No 4.* ‡*1 Plate, elevating, with screws.*	*1 Cinometer in case.*	*1 Driver, screw.*	*1 Cylinder, with 6 bits*
	1 Line, Hambro'		*4 Cloths, sponge.*	*1 Hook, borer.*
2 Spikes, common.	*1 lb. Slow match.*	*1 Pocket, tube.*		*3 Vent servers & lanyards.*
1 Knife, clasp.	*1 lb Marline.*			*2 Pins, tinch, one 1st & one 2nd class*
	1 lb Twine, packing.			*1 Washer, drag, 2nd class.*
25 Friction tubes.	*3 Lanyards* *1 Pummel, how.* *3 Washers, leather, plug, filling buffer; in tin box*	*1 Stick, portfire* *1 Key, fuze, universal, Mark II* *1 Line & 1 Reel, line, carpenters.* *4 ozs of chalk, white.* *1 Spanner, buffer No 6.* *? Portfires.* *1 Driver, screw, shrapnel, large.*		*20 Ties, tinch pin.* *1 Key, powder case.*

※ *17 in for 8in Howitzer.* ‡ *Placed in box, when not in gun, to prevent injury.*
12 in for 6·6 in do

Wyman & Sons, Ltd, Lith, 63, Carter Lane 6089.3.95.